臺灣的航海帆筏及其起源

凌　純　聲

近年以來研究人類學的美洲專家 (Americanist) 有一新的趨勢，他們對於各自專門研究地區的民族文化以外，而於文化史的基本問題，卽文化的起源與發展的過程亦發生興趣。如1949年國際美洲專家會議(The International Congress of Americanists) 在紐約舉行會議時，提出有關亞美兩洲文化關係 (cultural connection between Asia and pre-Columbian America) 的論文十餘篇；又 1951 年美國科學促進會 (The American Association for the Advancement of Science) 在費城 (Philadelphia) 舉行第一一八次會議，人類學組討論三天關於亞洲與北美橫渡太平洋的文化接觸問題 (Asia and North America Trans-Pacific Contacts)，共提出論文十四篇。多數主張亞美兩洲文化的遷移不僅道經伯令海峽，亦有橫渡太平洋的。而且有許多舊世界文化的影響到達新世界在不同的時代和來自不同的地區。至於研究太平洋各島民族文化的海洋專家 (Oceanist)，對於文化遷移亦有類似的問題，尤其在1948年，挪威人類學家 Heyerdahl 氏領導 Kon-Tiki木桅自南美秘魯到達太平洋 Tuamotu 羣島航行成功以後，更是引起興趣。Heyerdahl 氏又將在一百五十年前，Joaquin Martinez de Zuñiga 所謂玻利尼西安、美克羅尼西安、菲列濱等民族文化起源於美洲(註1)的舊說，重新提出，亦主張玻利尼西安民族文化，來自南北美洲。但Heine-Geldern 氏則反對此說(註2)。

直到目前，在美洲、太平洋、亞洲三區已找到很多顯著的相同文化特質，美洲文化源於亞洲至少受到其影響的理論，應該爲一般人都承認了，但是還有許多美洲專家直到現在，仍堅持他們的美洲文化獨立的觀點，一方面固由他們對亞美文化的關係，缺乏研究，同時在哥倫布之前，人類能橫渡世界最大的太平洋是件不易使人相信的事，例如Merrill 氏說："苦行的佛教信徒，當時海船既陋且小，要渡過太平洋，是一不可

(註1) Zuñiga, 1803, pp. 26-30.

(註2) Heine-Geldern, 1952, pp. 314-362.

能的航行"(註1)。

作者對於太平洋文化遷移的理論亦感興趣，尤其我是中國人，美洲和海洋洲專家所列舉的文化特質，在中國的先史、原史、歷史、民族、民俗各方面，常能找到十之七八，根據事實，不得不使我贊同橫渡太平洋接觸一方面。我個人覺得凡我研究亞美兩洲文化關係的同道，應先多人來研究古代亞洲沿岸的航海問題，如能證明在紀元之前，亞洲人確已利用桴栰、方舟、樓船在海洋上航行，則整個太平洋成爲亞、美、海洋三洲處處可通的大路，如此或可使現持反對意見者不得不承認我們的理論。因此作者根據中國資料，擬寫臺灣的航海帆筏及其起源和紀元前中國方舟與樓船的航海考兩文，本篇是前者，意在拋磚引玉，希望海內外之人類學專家，有多人來從事於此項研究。

一、臺灣的航海竹筏

臺灣的竹筏大別之有航行湖川與海洋兩類：前者僅在河川(圖版I:1)或湖泊(圖版I:2)上運輸捕漁作業，行筏使用划槳或撐篙，筏之構造較爲簡單，筏身多數是平底；後者則須出海作業，航行主要使帆，而以划槳爲副，筏身造形須前後彎曲，構造上故亦較爲繁雜。本文範圍祇限於航海竹筏。餘詳任先民君臺灣竹筏一文。

根據民國四十三年臺灣農業年報的統計，臺灣的無動力漁船 (fishing boat without mechanical power) 共計21,541艘，其中竹筏 (bamboo raft) 有13,808隻(set)，幾佔總數三分之二，餘三分之一爲木船，反比竹筏爲少。臺灣一島現已成爲世界上使用航海竹筏最多之地。

航海竹筏在臺灣又有近海與遠海之分，近海竹筏僅用槳划(圖版I:4)，遠海則槳帆兼使，故可簡稱帆筏(圖版I:3)。著者民國四十四年冬和四十五年春調查臺東縣之新港、大武，屏東縣之枋寮、東港，高雄縣之紅毛港、茄萣，臺南市之安平等港的航海竹筏。中以茄萣港造筏技術和航行技巧最爲有名，因此本文以一茄萣帆筏爲例。

(一) 航海帆筏的構造

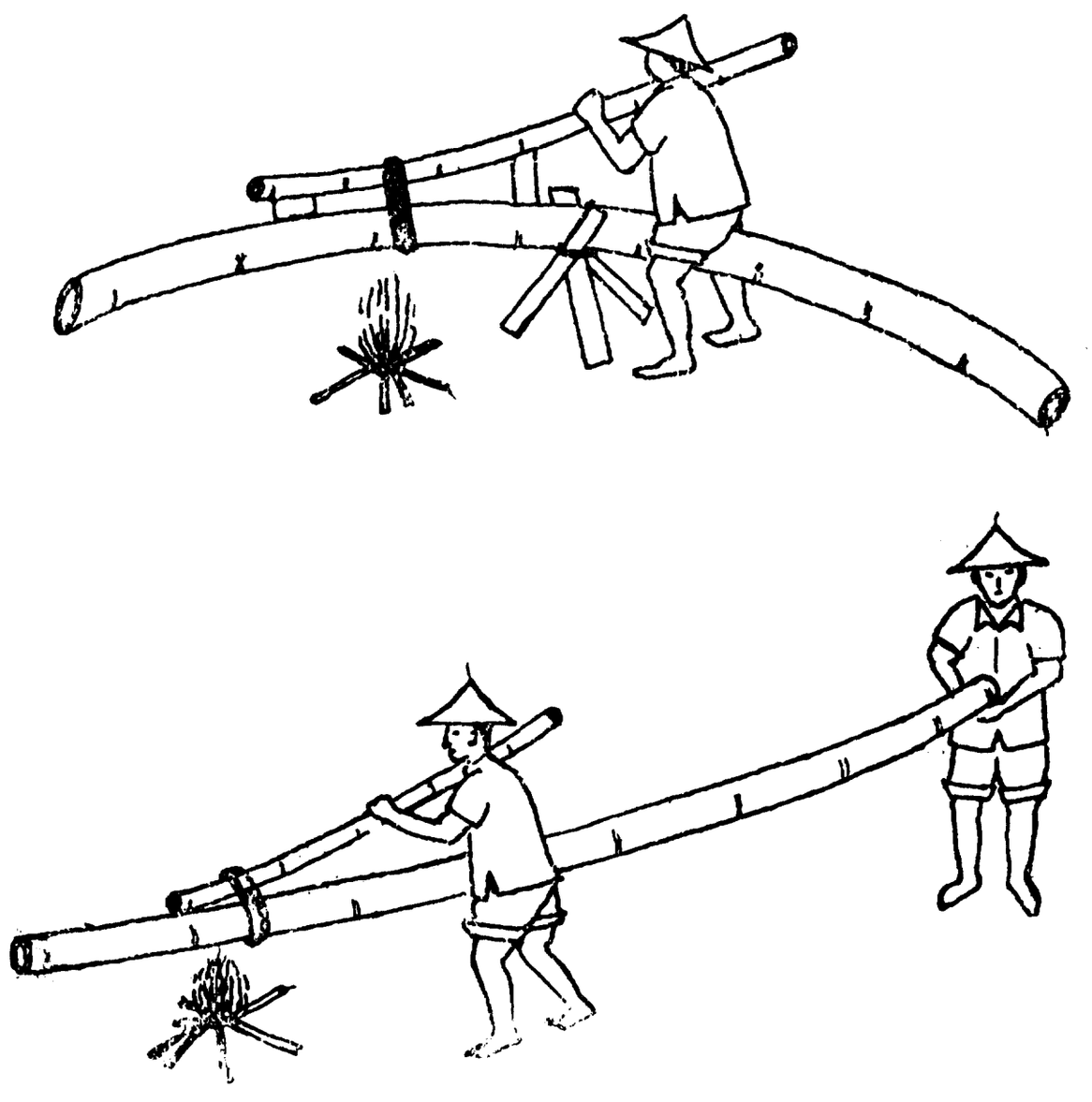
茄萣帆筏(圖版II)的構造，可分筏身、桅帆、槳舵、插板、石錨五項來敍述。

1. 筏身　構成筏身的主要材料，爲麻竹及刺竹共九根或十一根，次爲其他木質

(註1) Merrill, 1950.

部份所需之木材，除桅桿及槳舵以外，尙需木料二十才以上，再次爲綁紮所用之藤篾(現已改用鐵絲)，藤篾每條長約六公尺，寬約一公分，每筏所需五十條以上。蔴竹產在臺灣中部臺中、新竹、彰化等縣山地，運至海濱漁港出售，每根長七公尺以上，粗細以自竹根上數至第五節爲準，細者圍圓四十公分，粗者有至七十公分，售價每根自六十元至二百元不等；刺竹較廉，因其就近均有出產；藤條來自本省東部，每條一元左右。

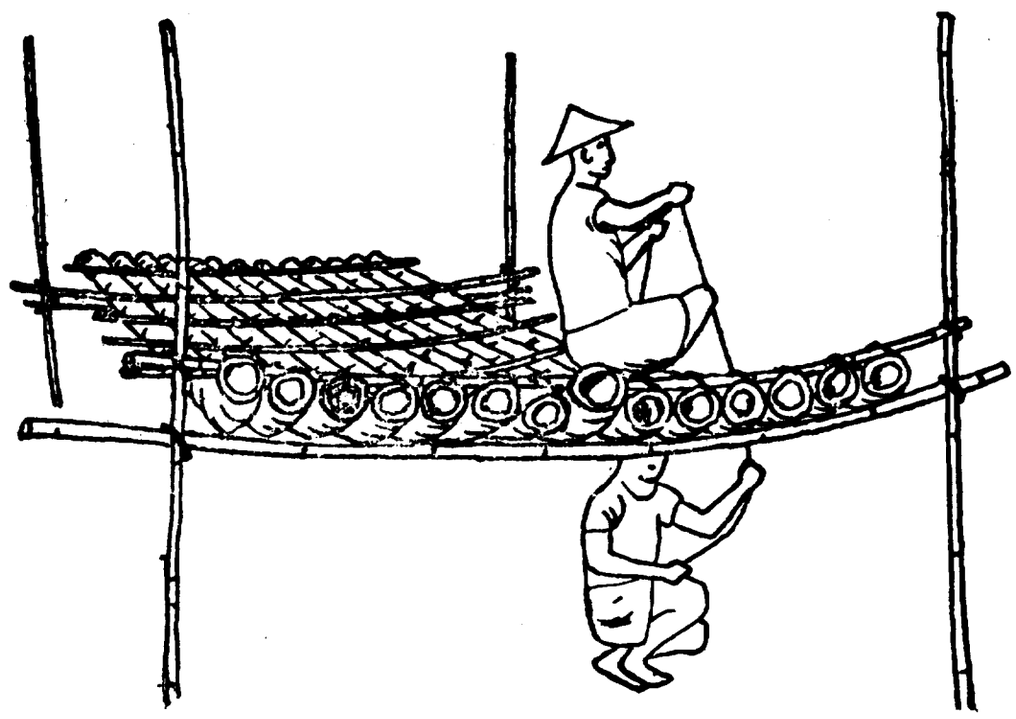
蔴竹及刺竹在製筏之前，均須削去竹青(圖版III:1)，其功用有四：a. 竹去青後，較輕易浮；b. 便於彎曲造形及紮筏綑綁牢固；c. 日晒受熱，不易開裂；d. 筏上載物人走，可免滑倒。去青之後卽須造形，所謂造形，卽將彎曲不直之蔴竹，在火上烤炙，用鋼絲環及槓桿之力上抬或下壓曲處(圖1)(註1)，使之矯直；並使每根竹前端彎曲成所需的弧度。刺竹肉厚質堅不易造形，所以造筏之前，卽須選擇其天然具有前端彎曲者，否則須於竹頭加接一段造形的蔴竹，使刺竹與蔴竹成一相同的弧度。



(圖1)

造筏所需之竹，造形工作完成以後，將之排列於高約壹公尺的木架上，竹根取齊(圖版III:2)，竹頭長短參差不大者任之(圖版III:3)。如有一二根過短時，以刺竹一段補足其長度，又筏頭之竹端恒有竹節，如遇有無節者，須以木塞或帶節的刺竹插入，外用竹篾藤皮紮緊，接頭處嵌以油灰再塗桐油，以防海水灌入腐蝕竹肉。編排方式，帆筏多數用竹九根至十一根，中央一根選最粗者，左右兩側第一根亦須較粗者，左右第三或第四枝爲刺竹，編排既定，分別於各竹全身塗以魚油或桐油，近日代以重油爲防腐塗料。魚油爲漁民取沙魚油脂煉成，成本低而功效劣，桐油最佳而價昂。塗料乾後，再依次排列架上，由三人或二人開始編紮，二人或一人在上(圖2)，一人在下，自中央

(註1) 國分，1947, pp. 38—29.



(圖 2)

分向兩端紮綁，用橫木八根紮八綁節，成七間節。編紮完竣，然後二竹之間，嵌置一小竹枝，有時筏面有一部份，舖以篾墊。筏身製造至此告一段落。再開始筏上其他木工部份構造。

2. 桅帆　桅桿多用杉木，取其直而修長，長度在五公尺以上六公尺以下。桅桿根圍約30至35公分，削成四方形，便於契合桅座。桅頂鑿一長條空槽，爲穿繩索繫滑輪之用，並懸一篾箍以約束升降帆時繩索的零亂。

桅桿座 (圖版 III:4 帶桅) 爲構造竹筏的重要部份，用長50公分，寬30公分，高22公分之長方形硬木塊做成，重可達四五十公斤。中央上下開一十公分見方之洞(圖版III:5無桅)以承受桅桿插入。左右側用二木條貫穿，木條長於桅座，用藤紮木條於筏上第三、四綁節橫木上，上兩橫木之距離，與桅座寬度相等。

帆爲白粗布所製，用寬60公分之布六條，直列縫合而成，全帆長約四公尺五十公分，寬約三公尺四十公分。用蔴線或棉線縫合，縫成後須用薯榔搗汁染爲咖啡色，乾後再染猪血，遂成暗紅咖啡色。每帆有緯桿十枝至十二枝 (圖版 VI:2)，用光直之小竹枝爲之，最上一枝須用較粗竹桿，亦有用木桿者，爲用以繫繩懸帆之着力主桿，其餘九根，平均間隔排列，最下一根，亦須較粗者，各緯桿上每距十或廿公分，用線釘帆布結牢，使帆受風力，亦藉緯桿分擔其風力，而免帆布脹裂，同時操縱帆在左右的位置，也須藉緯桿之力。緯桿之長度依帆而定，上短而下長，每桿末端有一繩，互相接至最後，由一根總繩綜纜之，用以控制當帆迎風時的鬆緊。

3. 槳舵　每筏共有划槳四枝和舵槳二枝(圖版IV:2)，用整根杉木做成。上圓下扁，頂端有橫圓木把手，全長三公尺半以上，底部最大寬二十公分。把手以下四十至六十公分處，環紮護槳(圖版III:6)，係長約二、三十公分，寬約一公分的小竹片若干，以竹篾或藤條繞槳身包紮，當划行時使槳身與槳柱間免致直接磨擦，而損蝕槳身。至於舵槳

的構造與划槳相同，惟其長度較短，而安置的部位近在筏尾。

槳座(圖版 IV:4)通常用楠木或其他硬木爲之，長二十至三十公分，寬十公分，高十五公分，中央有二、三公分見方之洞，以插槳柱，柱長二十至三十公分，上端有槽溝，以掛槳繩。划槳槳座用藤紮於筏舷竹桿上，另以支柱一根，一端嵌入槳座，一端綁於筏身蔴竹上，增加其穩定。舵槳槳座則固定於筏尾第七節間兩側之蔴竹上。因划槳爲推進筏身，故槳座較高，支點升高，槳身入水深，划力和推進力均增大；舵槳雖槳舵兼用，然主要作舵，使航向的變換，爲求便於移動，故槳座較低。

4. 插板　航行遠海帆筏，插板 (center-board) 爲其最重要的部份，普通一筏有插板位置六處(圖版 IV:1)，可用插板六塊，爲前中後各二塊，分開命名，可有前左、前右、中前、中後、後左、後右之別。中前和中後均插在筏之中部，故又可稱中央板，而又以中後板爲最主要插板。但六塊插板，可省去其三，而以三板施用於六個位置，卽前左、前右、中前共用一板，中後獨用一板，後左、後右共一板。

插板的構造，取樟木整塊，中央之中後板長70至90公分，寬50至80公分，截爲長方矩形，上緣夾二小條板，以爲握手之處，下緣略削薄以便利插取。前後板大小約爲中板二分之一弱，但無嚴格的規定，有時因湊材料，而大小不一(圖版 IV:3)，其構造多相同。中央板在桅座的前後，用竹桿挖一長空槽，可容插板的寬度，爲插板槽，槽置於二蔴竹之間，綁於第二至第五節桿之上(圖版 IV:5)。前後插板因較薄而小，無插板槽，在筏頭和尾的兩側，卽插於二蔴竹的隙縫間，插入取出以及升降較爲便易。

5. 石錨　竹筏之錨(圖版V:6)，以木質幹條紮成單鈎狀，於幹上綁以相當重量的卵石，錨因石之重量下沉，而入海岸泥沙之內，越沉錨鈎越深，使竹筏穩定不易飄動。

6. 其他　筏上除上述之航行工具外，尙有常帶的用具四種：水桶或有蓋水盆，係一圓盆，有釘牢之蓋，在蓋緣的一角，開一半月形之口，以便取水(圖版 V:2)。沉網石(圖版 V:1)，係取卵石若干，在石腰鑿槽，再繫繩而成。墊網蓆以竹篾編製，成長方形，常置筏頭(圖版 V:3)，用墊漁網。海燈(圖版 V:4) 用竹篾扎燈，外罩黑色紗布，上下透氣，再綁於平行之二蔴竹上，以長繩繫之，漂浮海上，以爲號誌。

(二) 帆筏航海的技術

臺灣帆筏多數航行遠海，本節所述的技術，偏於遠程航行，如何使用划槳、風

帆、舵槳、插板四者巧妙配合。雖遇頂風，亦可使帆航行。如遇颶風四至，不能張帆，則用划槳推進。海上波濤洶湧，不致漂流迷失航途。卽在驚風駭浪之中，要能避免筏身傾覆。故筏在海洋航行，速度雖遜於舟，而安全則遠過之。

1. 划行　筏在近海或短程航行，多用划槳推進，如駛帆海上中途風息，筏行停止，亦須划行。又在海上突遇暴風雨，無法扯帆時，勢必划槳推進，繼續航行，或加速逃避風暴。所以筏後舵槳槳座，亦爲划槳而設，因每一筏尾第三和第四、第八和第九蔴竹之間，各扣一繩圈以繫舵槳(圖版V:5)。故遠航竹筏，雖主要駛帆，而划行亦甚重要。

2. 使帆　臺灣竹筏出海，所謂開筏，意卽掛帆。就要注意風向和風級。

（1） 風向　帆筏航行海上，可能遭遇的風向甚多；然竹筏本身，均可改變其方位，以迎風向。使風向作用於帆之力的方向，與航向平行或相似，終能達到目的。因此無論海上風向如何，作用於帆之風向只有二種，換言之帆筏航海，只藉兩種風向前進，就是：a 順風，b 偏風，而偏風又有左右之別，亦可說有三風向，逆風因筏位改變而成偏風，故亦可航行。

a. 順風　風向與航向相同，風自筏身後方，直接推帆前進，爲航筏時最理想的風向(圖版VII:1)。

b. 偏風　又名斜風，風向與航向在筏身或左或右兩側成45度的偏差，如在左右後方，仍爲理想的風向(圖版VII:2)。如在左右側風向與筏身成90度時，仍可放鬆帆索行駛(圖版VII:3)。

c. 逆風　如遇逆風，只需將筏身方位改變，使與風向成45度，或90度的角度，航行S形路線，仍可達到目的地 (圖版 VII:4 a.b.c.)。

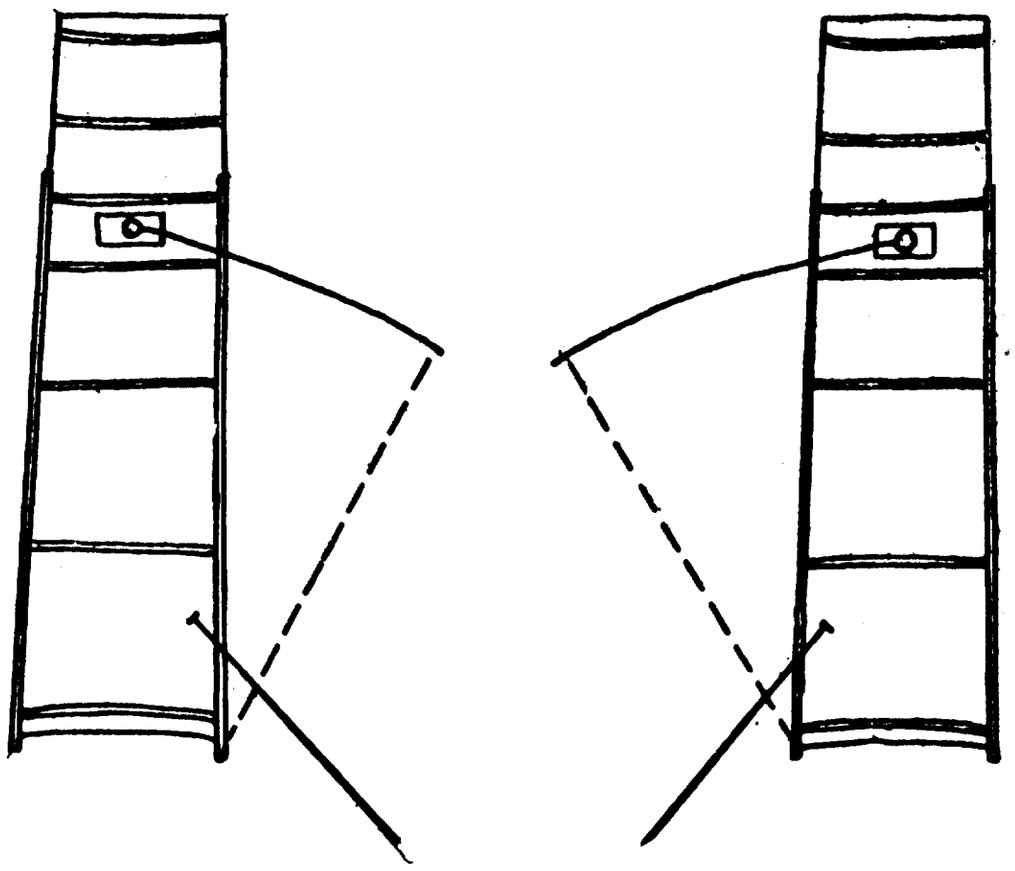
d. 帆位　風向與帆位的關係，順風帆在原位扯起，如遇偏風與逆風，帆位時常改變。風來自筏左，則帆必在右；風來自筏右，則帆必在左。因風向作用於帆之力，與帆作用於風之反作用力，二者之合力卽爲賦予航行方向之力(圖版VII:5)。

（2） 風級　風向決定帆位之後，就要注意風級。竹筏航海感應的風級，不如一般船隻之多。竹筏本身重量較輕，不能負荷太大的風力，否則易致翻覆。臺灣使用帆筏航海的漁民，只行五分風至八分風，五分風以上，可張滿帆，八分風以上，風力太强，竹筏不勝負荷，多不能扯滿帆。但其所指五分風、八分風，並無明確風級的概

念，僅憑其經驗行之。海上無風時極少，駛帆的機會甚多，除强烈風暴外，均得揚帆航行，卽八分風時，亦可扯半帆或三分之一帆行駛。

半帆在風力過强時、航海歸來進港或靠岸時、中途須減低航速時行之。滿帆在風力適中時、出海航行離岸時，均可掛滿帆。行駛滿帆，因張風力較大，筏身常易傾斜，竹筏爲一平面，筏舷甚低，又無筏艙，若傾斜太大，筏上所載之物，易於倒傾入海，故駛滿帆，應隨時注意風力的强弱。又在海上航行，無論半帆或滿帆，其張風力的大小，控制帆之角度，均極重要。其操縱在於帆索的放鬆與收緊。帆索收緊時，受風之張力大；帆索放鬆時，受風之張力小，故當海上風力驟强時，多放鬆帆索至最大限度，任帆隨風飄展，使帆受力減少而免致筏身顚覆。

3. 槳舵　操縱筏身的方向以定航線用槳舵。槳舵安置方法有三種：通常掛在筏尾左右二側的槳座上(圖版VI:1)；或穿入筏尾左右的繫槳繩圈內；亦有只置一槳舵於筏尾中央者(圖版VI:3)。在左右二側者，當其變換方向時，亦只用其一槳，帆面在左則用左槳舵，帆面在右則用右槳舵(圖3)。轉向時槳舵與筏頭爲同向，卽當筏身要改右向航行時，將槳舵亦扳向右方，反之則左(圖版VII:6a.b.c.d.)。用左槳舵時，右槳舵可以收起不用，以減少其在水中的阻力，若風勢不强，波浪不大時，亦可不必收起，則使用時增加便利。



(圖3)

4. 插板　桴筏揚帆海上，插板是最重要的航行工具。其功用可以平衡筏身，穩定航向，減少傾斜度，避免筏身左右漂擺。

筏身是一平面，浮在海平面上，其重心卽在筏身平面之上，加上桅桿及帆行駛時，筏身以上所負荷桅、帆及風力，大於筏之本身重量頗多，因而形成頭重脚輕的現象，易遭傾覆，故必須於桅座的前後，及筏頭尾左右方加置插板，以降低筏身的重心，而使筏身平衡(圖版 VIII:2)。

又因帆筏航行海上，係漂浮海面，易爲海浪或海流所漂動，無法控制航向，如加插插板之後，因插板深入筏底海水中，除可破水減少阻力易於前進外，並因藉海水兩側的壓力，使筏身不因水流而失其航向(圖版VIII:4)。

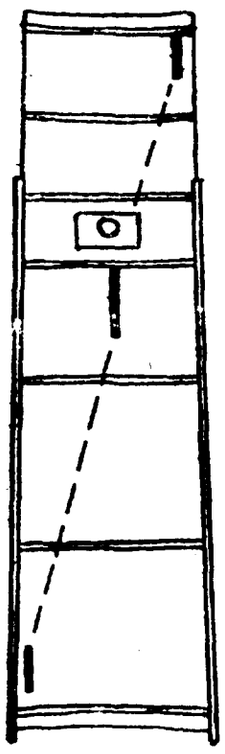
海上航行滿帆，或風力强大行半帆時，因帆受風力大，筏身常易傾斜於下風受力的一面。平面竹筏，稍受傾斜，卽難維持重心的平衡，加插插板以後，其重心降低，同時插板在水中所受的阻力，適可抵消大部桅帆所受風的壓力，藉使筏身傾斜度減少(圖版VIII:1)，而免傾覆的危險。

大洋之中，波濤洶湧，常易使漂浮海面之物，左右漂擺，竹筏旣輕且浮，當亦難免漂擺，如有插板插下，則波濤作用於插板左右之力互相消長，可以減少漂擺過甚之苦(圖版VIII:3)。

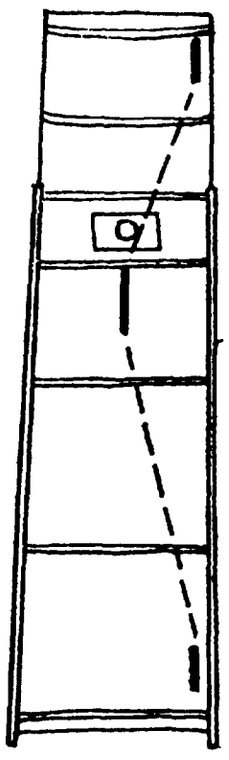
臺灣航海帆筏插板計有三至六塊，前板中板後板各二塊，而以中後板爲主，已如前述。帆筏離岸升帆時，卽須將中後板插上，入海較深時，插板插下亦較深，遇滿帆時，或風浪較大，整板均須插下，半帆或緩行，風浪較平靜時可只插半板；總之海上風浪千變萬化，中後板深淺的程度，亦須臨機升降。大筏、小筏遇强風時，除中後板外，多加插中前板，其法與中後板相同。當筏身轉變方向時，中後中前板須上升三分之二，以免在水下阻力太大，轉向之後，仍須插下。

後板可分插於筏尾左右二邊，其功用與中板相似，插法則略異，帆在左時插左後板，帆在右時插右後板。蓋左帆因風力使筏身傾向左方，須加插一板，自水中取其對消的反作用力(圖版VIII:5)；帆在右時，其理相同。當筏身變換方向時，亦須同時取出。

前插板在筏前端左右二側，平時航行用者很少，在遇逆風，或風浪過大時則加插之，因其逆風航行，帆受風力所賦予筏傾斜的一面入水深，前插板應插於筏身斜入海水的一側(圖版VIII:6)，藉插板在水中之反作用力量，以平衡筏身。航行時帆或左或右受風力，則筏身任一側傾斜入水時，前插板卽應插下，同時也可以



(圖4)



(圖5)

藉插板破浪，而增加航行時速率。此時前中後三插板在同側成一等邊三角形(圖5)。又當在海上遇到風浪過大時，則前插板應插在與後插板相反之一側，因風浪大時筏身傾斜亦大，前後插板置於相反之位置，使插板受海水反作用力之面積加大，而穩定筏身，同時插板分散，受水阻力亦大，可以降低航速，以求航行之安全，此時前中後三插板，排列成一斜直線形(圖4)。

航海帆筏，多用兩人駕駛，一人負責桅帆及中央板：司帆的升降、繩索的整理、中央板的插放；一人負責槳舵帆索及後板：司筏身方位的變更、航向的確定、以及帆索的鬆緊、受風力的大小、帆在筏左筏右的調度、後板的插放。航行海上，二人必須通力合作，方能獲得航行良好的效果。又西洋學者常稱臺灣帆筏爲三人竹筏 (the three men raft of Formosa) 其餘一人在筏前專管捕魚，然遇緊急必要時亦划槳司插前板加入駕駛。

二、太平洋及其沿岸帆筏的比較

前節所述爲臺灣帆筏普通所用和最多的一種，現在要作比較研究，應將臺灣的較早和較少有關帆筏資料，簡略敍述，藉作比較之資。臺灣帆筏遠程航行的紀錄最早見於宋史卷二百五十流求傳：

> 流求國在泉州之東，有海島曰澎湖，烟火相望。……淳熙間(1174—1189)國之酋豪嘗率數百輩，猝至泉之水澳、圍頭等村肆行殺掠，……不駕舟楫，惟縛竹爲筏，急則羣舁之，泅水而遁。

至清康熙五十六年(1720)諸羅縣志卷八引馬貴與紀流求云：

> 不駕舟楫，惟以竹筏從事，可摺疊如屏風。

上錄祇有文字紀載，僅知筏形如屏風，其他資料甚少。在1803年日人秦貞廉所記臺東秀姑巒帆筏(圖版IX:2)始有圖有錄，他說：

> 竹舟長凡四尋餘，幅大抵七尺許，左、右、後三側剖竹編製爲舷，以竹篾編織成帆。舟尾部，設竹枱，爲用餐與休息處。乘二、三人操作漁事(註1)。

(註1) 秦貞廉，1803, p. 52.

上圖在竹筏上加上較高之舷，除筏頭外，驟視如舟形，故名竹舟，實則透水(wash-through) 的原則同於竹筏。筏尾有一較高的平臺，帆用蘆葦或竹篾編成，異於今日臺灣西部之筏。

臺灣西部高雄縣紅毛港等地尚有一種小型的帆筏(圖版VI:4)，航行於近海與內海。筏身僅用刺竹、蔴竹五根構成，划槳一對。最引人注意的，爲此種筏的桅帆，似斜杠帆(sprit sail)。先以一較粗之竹爲桅桿，再以較細竹桿，一端紮在桅桿三分之一高處，成一倒三角形 (apex downward)，以長方形帆布一塊，一邊繫紮桅桿上，帆上面一端繫結斜竹的上梢成三角形的底邊，帆之外邊上下角各繫一帆索，使滿帆時成長方形，半帆則爲三角形帆。

東亞除臺灣外，越南亦有航海帆筏（註1），筏身用竹構成，筏上且有前後兩帆，多至三帆，插板有前、中、後三塊，筏形亦近似臺灣竹筏(圖版 IX:1)。

在太平洋中，Friederici 氏雖說："在遠古之時，馬來玻利尼西安人的遷移是航行一種式樣完備的大筏"(註2)。但早期的航海家和人類學家或多注意太平洋的邊架舟(outrigger canoes)，關於帆筏記載較少，現在祇有 Mangareva 島的木桅，Beechey 氏繪有簡圖，尚可作比較之資。Beechey 氏說："在 Gambier 島不見木舟，代用以筏，筏長四十至五十英尺，可載二十人。用樹幹，加橫木，以繩紮成。有三角形帆，用兩桿支起帆之兩端，但祇風順可使帆，如其時二三隻筏同一航向可以繫結起來同航。遇風不順，則用光黑硬木大槳划行"(註3)。

關於南美沿太平洋岸的帆筏，保存下來了圖畫和紀錄，資料最多。本文所收，最早的爲 Benzoni所繪之桅(圖版 XI:1)。氏意大利人，於1540至1556年間，旅行南美西班牙屬地包括秘魯，1565年出版新世界史 (History of the New World) 附此桅圖，由七木桿構成，桅上水手七人，桅頭有簡陋之帆(註4)。其次爲上文已引的 Spilbergen 氏於1614至1617年，環航世界時，在秘魯的 Payta 港遇到的帆桅，繪有簡圖(圖版XI:2)。筏上有水手五名，二人管帆，三人坐在甲板司中央板的升降。甲板上置水甕四個，似

(註1) Claeys, 1942, pp. 17-28.

(註2) Friederici, 1928, p. 29.

(註3) Beechey, 1831, p. 143.

(註4) Benzoni, 1857, p. 242; Heyerdahl, 1952, p. 528.

石磨物三件，可能是石錨。筏上前後兩帆，帆爲三角形。此筏出海捕魚兩月，其時正在歸航(註1)。

至十八世紀初葉，南美自 Ecuador 經秘魯至南緯八度一帶海岸，balsa 桟仍甚常見。西班牙的海軍軍官Juan 和 Ulloa 兩氏對 balsa 的構造和航行的技術有詳細的研究，如圖所示(圖版XI:3)，筏用 balsa 木九根紮成，長75或90呎，濶約20至24呎(註2)。

一百年前，研究木桟構造最詳盡者，當推 Paris 氏，氏在 Guayaguil 港，實地調查，繪有詳圖(圖版 XI:4)，筏長80至90呎，濶23至30呎。

在南美東部巴西尙有一種帆筏，其帆爲三角形(圖版 X:1)，其航行亦用插板。又近代巴西木桟所用之帆，很像玻利尼西亞的倒三角形帆(註3)。

以上起自東亞橫渡太平洋而抵南美，在此廣大的區域中，我們祇收到八張航海帆筏圖，材料雖不能算多，然亦勉强可作比較研究。

筏形　造筏所用的材料不同，筏形因之而異。南美木桟中央木桿最長，向兩邊漸短，成兩頭尖的筏形。東亞竹筏，因竹有彈性可以造形，多成筏尾平齊，筏頭上是近似舟形。如爲葦筏，造形更易。 上面 Benzoni 氏圖木桟亦是頭高尾平，近似臺灣筏形，這值得注意之點。木桟或竹筏的大小，須視造筏所用木桿或竹竿的多少，帆桟至少自五，而七、九、十一、十三根木或竹桿。七、九較多，而九桿爲最多。

桅帆　南美帆筏的桅桿有兩種：一爲單桅(pole-mast)另一爲剪桅 (sheer-mast)，卽以兩桿頂端相交，成一倒V字形。大筏多用剪桅，如用單桅，則常前後各一，多至三桅；小筏用單桅。亞洲臺灣和安南多用單桅，而較大之筏，則加多一二桅。長江以南的河川中，較長的木排運輸，多用剪桅 (圖版 X:3)。竹排排數較少而較短，則用單桅(圖版X:2)。

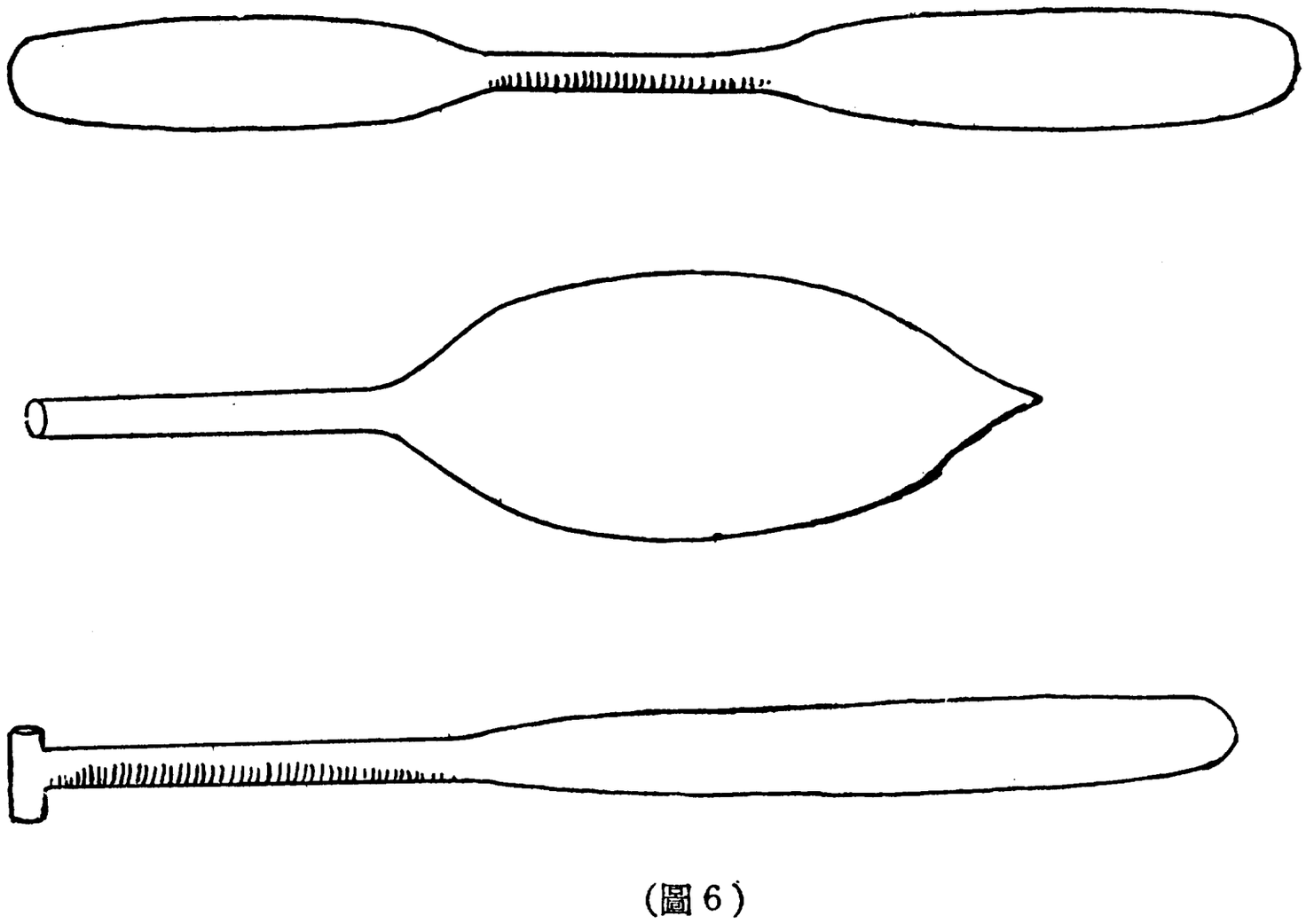
帆形共有方形(包括長方形和梯形)、正三角、倒三角三種，南美三者均有，臺灣可說有一、三兩種，太平洋祇見倒三角形帆。方形、長方形和梯形之帆式樣較古，因臺灣以竹篾，江南用蘆蓆做成之帆，多成方形或長方形。

(註1) Spilbergen, 1619, p. 83; Heyerdahl, 1952, pp. 530-531.

(註2) Juan and Ulloa, 1760, p. 186.

(註3) Hornell, 1946, p. 82; Heyerdahl, 1952, p. 591.

槳舵　栈底成一平面，不易裝舵，因此以槳代舵。槳因栈之大小而有三種：大栈用單槳，兩邊划行；中筏用雙槳，人在筏中推划；小筏用兩頭槳，人坐筏中兩面划。南美曾有一三兩者，臺灣現有二三兩種，臺灣東部花蓮臺東兩縣的阿美族，至今多划兩頭槳，乘小筏出海捕魚。栈槳型式大同小異如(圖6)所示：

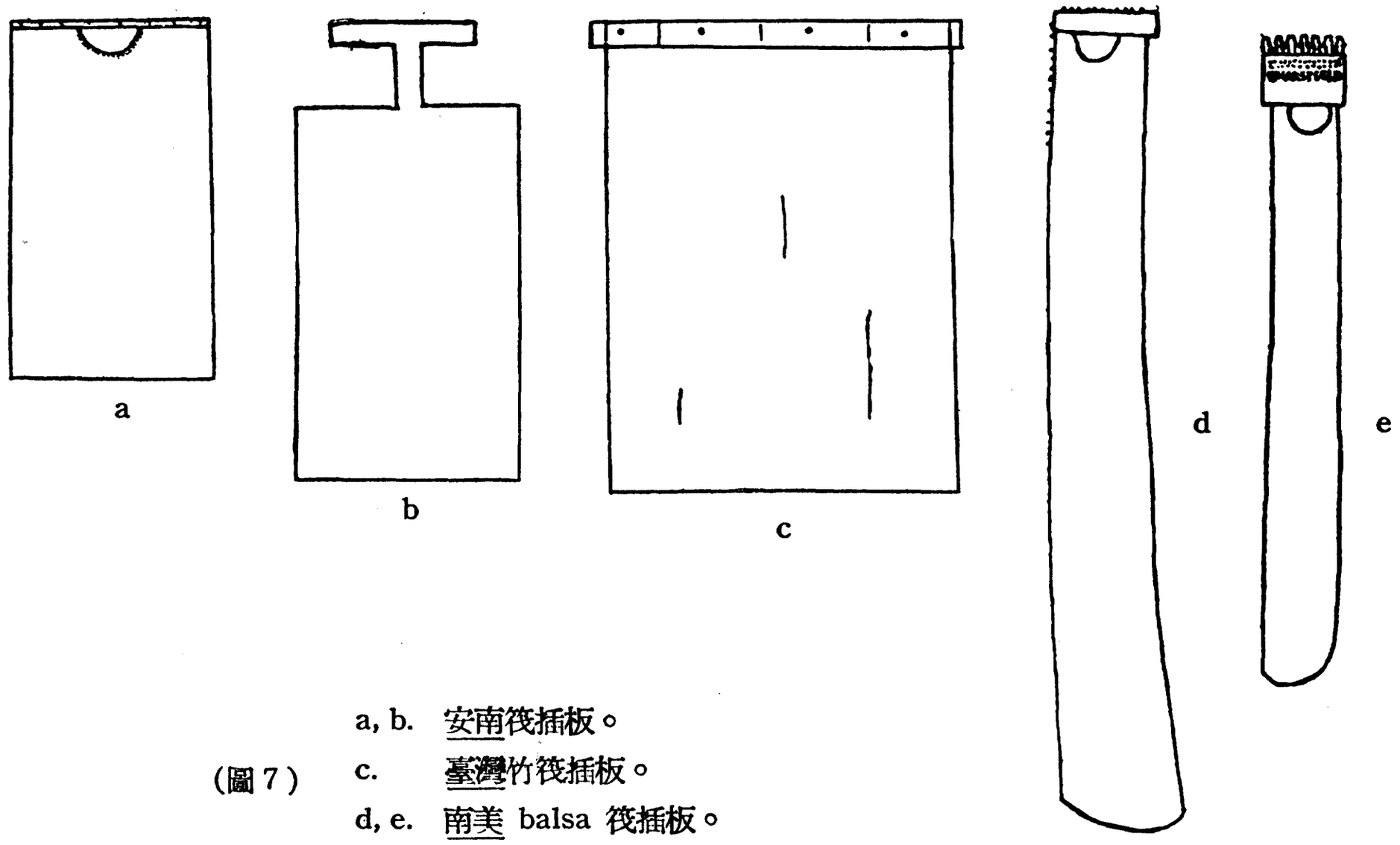


(圖6)

插板　南美插板土名 quara，臺灣土語 tʃ'iam，英文譯名中央板 (center-board)，作者因爲 quara 不僅插在筏之中央，前後左右均插，臺灣舊名舵仔，又恐誤以爲舵，不如叫做插板，名實相符。現在已知東亞的臺灣、安南，南美的秘魯、巴西四地的航海帆筏均用插板，如圖7所示：插板用於筏之大小，而有長短寬狹之別；大筏常有三層圓木(圖版XI:4)，甲板離水較高，插板須長而狹，板數要多，插取升降較爲便捷。臺灣竹筏僅有筏身，插取甚易，插板可大而寬。

上文所收帆筏之中，祇有Beechey氏和 Benzoni氏 的兩栈圖上沒有插板，筏在岸上插板多是取出，至在水中更不易看出，太平洋中之栈，迄今雖尚未有插板發見，然我們不能斷言無插板存在，因 Mangareva 栈能至 Rarotonga 往還航行，帆筏如無插板，遠程航海幾爲不可能之事(註1)。Benzoni氏之栈，圖上雖無插板，但1857年，英國海軍少將 W.H. Smyth 氏翻譯 Benzoni 氏著新世界史，註釋 Benzoni氏的栈說：

(註1)　Heyerdahl, 1952, p. 593.



(圖 7)　a, b. 安南筏插板。
c. 臺灣竹筏插板。
d, e. 南美 balsa 筏插板。

"這種大的balsa 桅掛帆在剪形的桅上。航行時如有需要，常升降插在筏之兩端木幹間隙的木板"(註1)。可見帆桅航海不能不用插板，再證之臺灣帆筏，開航掛帆，同時即插插板，甚至臺東划筏，出海稍遠，亦用插板。

至於桅之航海技術，Juan 和 Ulloa 二氏說：

桴桅最大的特點是能在逆風中，使帆、搶風、航行一如有龍骨之船。這是由於除舵外另用一種航行方法。就是利用幾塊木板，長三四碼，寬半碼，叫做guaras，插在筏之前後木桿間隙，將板升降，離開(bear away)，搶風 (luff up)，逆風 (tack)，定向 (lay to)，能做普通船隻的種種動作(註2)。

Paris 氏亦說：

航行用木板，名 guaras，直插木桿間隙，插下深淺不同，或前或後，即可側風航駛，桅在洋上無其他方法航行(註3)。

又 Emilio Estrada 氏於1953年在 Ecuador 的 Playas 海岸試驗木桅航行，亦用六塊插板，二在桅頭，二在桅尾，同於臺灣(註4)，所以南美桴桅的航海技術，以臺灣的來比較，可說完全相同。

(註1) Smyth, 1857, fn.; Heyerdahl, 1952, p. 528.
(註2) Juan and Ulloa, 1748, p. 189.; Heyerdahl, 1952, p. 538.
(註3) Paris., 1841, p.148.
(註4) Heyerdahl, 1955, pp. 263-264.

我們上以東亞和南美帆栈的構造和航法，作了較詳的比較研究之後，使人不能不設想兩地之栈是同源的。

三、太平洋各地及中國桴筏名稱的研究

由上面的比較研究，可見南美洲、太平洋及東亞桴筏的構造、航行的方法可說是大同小異的。不僅如是，連三區桴筏的名稱，至今尙能保存相同的通稱，茲再分述之。

在南美洲西海岸之筏通稱 balsa，是由西班牙航海家 Bartolomeo Ruis 氏傳聞於世。在1527年二月下旬，Ruis 氏經過舊金山角 (Cape San Francisco) 航近赤道，始見掛帆之筏，土人叫做 balsa，編若干輕鬆大木而成，筏面舖有葦蓆，兩桅樹立船之中部，上掛方形布帆，航行時使粗製之柁及一活動的龍骨 (a moveable keel)，用木板製成，插入筏木的隙縫中，能使水手定桴栈的方向，依航線前進，不須用槳 (註1)。

至1614—1617年間，Joris Van Spilbergen氏環航全球，在秘魯的 Tumbez 南一百二十哩，訪問 Payta 港，軍艦向一漁筏購魚，他說："是一野人之船，叫做 balsem，他們出洋捕魚，能乘風航行"(註2)。

著名的秘魯史家 Means 氏說："balsa 一名，不是 Quecha 語，亦非 Colla 語，可能是出於 Guayaquil 灣附近的方言。初指 balsa 樹及其木材，言筏僅爲原義的假借"(註3)。但十六世紀末葉，Cabo氏說："當地稱此爲筏木 (balsa timber)，因爲用以造好筏(good balsa)"(註4)。可見Means氏之言不確，Heyerdahl 氏說："balsa一語的起源不甚明白。……我們知道 dalca 一語，是智利沿海小船或獨木舟之土名；而 vaka 一語，在玻利尼西亞是船或獨木舟之通稱"(註5)。

德國工程師 Brüning氏 居留秘魯五十年(1875—1925)，Heyerdahl氏說："他可能是最後一個人親見現已不用的 balsa 筏"(註6)。Brüning 說："在秘魯的 Pimentel, San José, Sechura 等海港，土著漁人利用破壞或廢棄的 balsa 木桿，造小筏，叫做 balsillas"。

(註1) Murphy, 1941, p. 7.; Prescott, 1847, p. 223.

(註2) Spilbergen, 1619, p. 83.; Heyerdahl, 1952, p. 530.

(註3) Means, 1942, p. 19 fn.

(註4) Cabo, 1653, p. 1.

(註5) Heyerdahl, 1952, p. 529 fn.

(註6) Heyerdahl, 1952, p. 544.

南美的筏 (balsa) 又名 Jangadas(註1)。Lothrop 氏說："Jangadas 係印度西海岸的筏名，由葡萄牙人傳入於南美巴西"。他又說："筏上架起平臺，蓋有小篷，在 Andes 山脈之西，分佈很廣；因此我們可以假定 Jangada 起源於南美內陸"(註2)。

在玻利尼西亞新西蘭東約四百哩的 Chatham 島，居民 Morioris 人"有一種航行深海的舟筏，叫做 waka-pahi 或 pepe，長五十呎以上，他的構造正合透水的原則 (wash-through principle)"(註3)。Skinner 氏摘錄 J. M. Brown 的記載說："他們 (Morioris) 的 waka-patu (waka-pahi) 使我想起秘魯海岸的 balsa 或桴桟，在 Titicaca 湖上，我看見同一型式（就是透水）用蘆葦紮成的筏，如 Morioris 人的一樣"(註4)。

伊斯特島的筏名叫 pora，據 Métraux氏說："該島居民所用的筏 (pora) 是用蘆葦簇捲成錐形的大捆"(註5)。

在大溪地，據 Enock 氏云："大溪地的 pahi 或筏船，據說似秘魯的 balsa"(註6)。

當 Tuamotu羣島土人看見 Kon-Tiki木桟，他們立即認識像是祖先所知的paepae。又 Mangareva 的筏伕稱他們用的筏亦名 paepae。在 Marquesas 和大溪地兩羣島，paepae 是筏的通稱。又 paepae 一語在玻利尼西亞方言中，義爲筏 (raft)、船板 (flooring)、平臺 (platform)、排行 (to place in a row)、排次 (to lay in order)，或爲浮 (to float)、漂流 (to drift)、順風而去 (to go to leeward)(註7)。

綜上的敍述，在美洲和太平洋中桴筏的名稱，最普通的有兩種：waka 或 vaka 和 paepae 或 pahi。而這兩名稱對於"刳木之舟"和"維木之桴"有時通用。著者根據這一事實，去研究中國桴筏的名稱，得到同一的結論，眞不勝令人驚異。茲將中國自

(註1) Paris, 1841, p. 148.
(註2) Lothrop, 1932, p. 253.
(註3) Shand, 1871, p. 354., 1911, p. 86.; Heyerdahl, 1952, p. 581.
(註4) Skinner, 1923, p. 119.
(註5) Métraux, 1940, p. 208.
(註6) Enock, 1912, p. 279.
(註7) Heyerdahl, 1952, p. 584.

古以來，凡訓桴筏之字分述如下：

1. 方　詩經漢廣：“江之永矣，不可方思”。又邶風：“就其深矣，方之舟之”。毛傳：“方，泭也”。

2. 舫　爾雅釋言：“舫，泭也”。孫注：“方木置水中爲栰桟也”。

3. 潢　廣雅釋水：“潢(橫)，筏也”。

4. 泭　爾雅釋水：“庶人乘泭”。郭注：“併木以渡”。國語齊語：“方舟設泭”。韋注：“編木曰泭”。楚詞九章惜往曰：“乘汜泭以下流矣”。王逸注云：“編竹木曰泭，楚人曰泭，秦人曰檒也”。

5. 桴　論語公冶長：“乘桴浮於海”。馬融曰：“編竹木也，小者曰桴”。國語齊語：“乘桴濟河”。韋注：“編木曰泭，小曰桴”。淮南子說山訓：“方車而蹝越，乘桴而入胡”。

6. 栰　管子輕重甲篇：“桀者，冬不爲杠，夏不束栰，以觀涷溺”。又兵法篇：“方舟投栰”。

7. 箭　廣雅釋水：“箭(敷)，筏也”。

8. 箭　釋文：“泭，郭音孚，字或作箭同”。

9. 筏　方言第九：“簰謂之筏(音伐)；筏，秦晉之通語也”。

10. 桟　論語：“乘桴浮於海”。馬融曰：“編竹木也。大者曰桟”。

11. 檒　楚詞九章注云：“泭，秦人曰檒”。說文：“檒，海中大船，從木發聲”。玉篇注云：“海中大船也，泭也”。

12. 簰　方言第九：“泭謂之簰(音敷)”。又廣雅釋水：“簰(薄佳)，筏也”。

13. 筏　後漢書岑彭傳：“將數萬人乘枋筏下江關”。注云：“枋筏以竹木爲之浮於水上”。鄧訓傳：“縫革爲船，置於筏上以渡河”。注云：“筏，木筏也”。

14. 簰　一切經音義卷三三：“簰上，敗佳反，方言簰謂之筏，南方曰簰，北人名筏也”。經典釋文：“簰，皮佳反，本又作簰同”。

15. 棑　唐韻：“棑，筏也”。

上面訓筏的十五個字，因時代和地域的不同而異體，其音讀歸類只有四種：

1. 方、舫、潢三字一類，方、舫二字早見且同音，今音讀 fang，中古音

piwang，上古音 piwang。潢字較晚，今音 hung. heng，中古音 ɣwɒng，上古音 g'wăng。

2. 泭、桴、桁、筏、筟五字爲一類，前三字較古；泭桁二字同音，今音 fu，中古音 p'iu，上古音 p'iu；桴字今音 fu，中古音 p'iu，上古音 p'iug。

3. 栰、筏二字同音，今讀 fa，中古 b'iwɒt，上古 b'iwăt；橃字晚見。

4. 簰、簿、箄、棑四字音近，與牌同音，牌或碑今音 p'ai，古音 b'ai。

由上歸納起來，有桴、筏、方、簰四種音讀的不同，在中國古代對於四者的解釋，有的以大小分別，如馬融註曰："大者曰筏，小者曰桴"。有以質料分的，郭璞曰："木曰簰，竹曰筏，小筏曰泭"。又有以地域分的，王逸曰："楚人曰泭，秦人曰橃"。楊雄曰："筏，秦、晉間之通語也"。至唐慧琳曰："南方曰簿，北人名筏"。

但自發明舟後，卽以原來筏名，以之稱舟，如說文："方，併船也"。又："舫，方舟也"。爾雅："大夫方舟"，李巡註："併兩船曰方舟"。方言："方舟謂之潢"。又云："舟，自關而東，或謂之舟，或謂之航"。可見方，舫、潢三者，古爲筏名，後變併兩船 (double canoes) 之名。橃原亦筏名，說文又曰："橃，海中大船也"。

又朝鮮半島南部，濟州、南海兩島，現在尙盛行一種原始的筏、稱爲 pal-son。pal是筏之意，son 是船之意。島民用以捕魚及搜集海草(註1)。

作者非語言學家，暫時對此無暇深入研究，根據上面的材料，至少可作下列的兩項假設：

a. 南美洲東部河川中和西部沿海的 balsa，與中國之栰的中古和上古音 b'iwat 近似，與朝鮮半島的 pal-son 更相似。

b. 在玻利尼西亞羣島的 vaka, waka, paepae, poepoe, pora, pepe, pahi, 諸名稱，多可說源於中國字的栰 fa, b'iwɒt；橃 fa, piwɒt；簰 p'ai, b'āi。

Heyerdahl氏與Heine-Geldern氏(註2)二人對於vaka, paepae, pahi,義爲舟或栰的爭論，根據上面的假設，可以作如此解決，大約在元前至漢時 vaka 和 paepae，亦作舟解，如上引："橃，海中大船也"。又後漢書西南夷傳："遣兵乘箄船南下江漢"。所

(註1) Shinji Nishinuma, 1922, p.59.

(註2) Heyerdahl, 1950, p. 23.; Heine-Geldern, 1952, pp. 332-334.

以南美洲的 balsa，海洋洲的 vaka 和 paepae ，這三者名稱假定多起源中國，則其遷移的時代，balsa 最早， vaka 次之， paepae 最晚；如其出發地點的不同，則vaka 在長江以北，paepae 在南方。

最後著者在此附帶說幾句話，近來因研究桴栰的名稱，而研讀 Friederici(註1)和 Hornell (註2)兩氏關於海洋洲舟名的分佈與遷移， 舟名的起源地不在中南半島即在印尼羣島，依據上述筏名的考證，要研究太平洋上船名的起源與分佈，中國文獻上數以百計的舟名，是不可缺少的最古和最重要資料。

四、桴筏的起源及其在紀元前的航海

桴栰的起源，在中國傳說甚古。羅欣物原曰：

燧人以匏濟水，伏羲始乘桴，軒轅作舟。

王嘉拾遺記卷一黃帝篇亦曰：

軒轅變乘桴以造舟楫。

淵鑑類函卷三八六引稗編云：

拾遺記曰：軒皇變乘桴以造舟楫。則是未爲舟前，第乘桴以濟矣。筏，卽桴也。蓋其事出自黃帝之前，今竹木之簰，謂之筏是也。

王嘉西晉末人，去古已遠，拾遺所記，當然不能視爲信史，然未發明舟之前，中國人已知用筏以濟，當是事實。如世本云：

古者觀落葉因以爲舟。共鼓貨狄作舟。注：共鼓貨狄黃帝二臣。

周易：

刳木爲舟，剡木爲楫，舟楫之利，以濟不通，蓋取諸渙。

可見最初作舟之法，是刳木爲舟，中國至黃帝之時，已知用玉製作工具兵器，據越絕書卷十一：

風胡子曰：黃帝之時，以玉爲兵，以伐樹木爲宮室鑿地。

因工具的進步，黃帝時雖發明了舟楫，然造舟非易事，不如編竹木而造桴栰的容易，所以舟與筏自古至今在中國並存，且更原始的匏葦渡水工具亦多存在，如莊子：

五石大匏爲舟，浮於江湖。

(註1) Friederici, 1928.
(註2) Hornell, 1931, 1946.

詩經河廣：

誰謂河廣，一葦杭之。

如在臺灣，直至清初，臺灣土著渡水工具尙用瓠、筏、舟三者，滿洲六十七著番社采風圖考云：

秋潦驟降，溪壑漲盈，腰挾葫蘆，徑渡如馳。

臺地南北大溪數十，寬廣無梁，經冬淺涸可徒涉，夏秋水泛，洶湧湍激，土目通事有事經涉，乘竹筏令番浮水繞筏扳援而行。

彰化水沙連社，背山環水，水橫數里，深不可測。漢人以貨到社交易，番以獨木鑿其中爲舟渡之名曰艋舺。

中國的桴桴不僅起源很早，且早已用於航海，如拾遺記卷一少昊篇云：

少昊母曰皇娥，處璇宮而夜織，或乘桴木而晝遊。經歷窮桑滄茫之浦。時有神童容貌絕俗，稱爲白帝之子。……帝子與皇娥泛於海上，以桂枝爲表，結薰茅爲旌，刻玉爲鳩置於表端，言鳩知四時之候，故春秋傳曰：司至是也。今之相風，此之遺象也。帝子與皇娥並坐，撫桐峯梓瑟。皇娥倚瑟而清歌曰：天清地曠浩茫茫，萬象廻薄化無方，蒼天蕩蕩望滄滄，乘桴輕漾著日傍，當其何所至窮桑，心知和樂悅未央。白帝子答歌：四維八埏眇難極，驅光逐影窮水域，璇宮夜靜當軒織，桐峯文梓千尋直，伐梓作器成琴瑟。清歌流暢樂難極，滄湄海浦來棲息。

以上所記，雖爲原史時代的傳說，然可推知遠古已乘桴航海，且知利用風帆，上言“鳩置於表端”，王子年註曰：“今之相風，此之遺象也”。東坡詩注曰：“晉車駕出，刻烏於竿上曰相風竿，今檣烏乃其遺意”。後以鳥羽候風曰綄，淮南子云：

若綄之候風也。注：綄，候風羽也。楚人謂之五兩。

又文選

占五兩之動靜。注：以雞羽爲之，重五兩，繫於檣尾以候風。

又淵鑑類函卷三八六引淮南子曰：

譬俔之見風，無須臾之定。注：俔卽五兩。

由上考證，可以確定“鳩置表端”，爲後之相風，檣烏，五兩，綄，俔，則“以桂枝爲

表”，爲桴上的檣桅；“結薰茅爲旌”，可能是帆。桴桴航海，主用風力，看風使帆，至今猶然。

至春秋時代（771—529 B.C.），中國海上航行尙用桴桴，如論語公冶長：

子曰：道不行，乘桴浮於海。

說文解字：

子欲居九夷，或曰陋！如之何？子曰：君子居之，何陋之有？

說文解字四上：

孔子曰：道不行，欲之九夷，乘桴浮於海，有以也。

漢書地理志曰：

孔子悼道不行，設桴於海，欲居九夷，有以也夫。

九夷，禮王制孔疏云：

九夷，依東夷傳九種曰：畎夷、于夷、方夷、黃夷、白夷、赤夷、玄夷、風夷陽夷。

皆海外遠夷別種，乘桴浮海可通。又越絕書卷八有云：

勾踐……初徙瑯琊，使樓船卒二千八百人伐松柏以爲桴。

越王勾踐滅吳後。遷都瑯琊，在紀元前瑯琊爲中國南北海道最衝要的海港，定都之後，新都與舊京間交通頻繁，所以要使樓船卒二千八百人，伐松栢以爲桴。且著者因上文懷疑桴爲用於普通航海之名，以之海戰則稱樓船，說詳另文。中國人能利用桴桴航海，因此海道開闢甚早，如禹貢有云：

淮海惟揚州……沿于江海，達於淮泗。

在春秋時代，濱海的齊、吳、越三國，海上交通均有確實記載。孟子梁惠王下：

昔者齊景公問於晏子曰：吾欲觀於轉附，朝儛，遵海而南放於琅邪。

左傳僖公四年：

陳轅濤塗謂鄭申侯曰：師出鄭陳之間，國必甚病，若出於東方，觀兵於東夷，循海而歸，甚可也。

左傳哀公十年：

徐承帥舟師，自海入齊，齊人敗之，吳師乃還。

國語越語：

越之入吳也，范蠡古庸帥師，自海詣淮，以絕吳路。

國語：

范蠡浮海出齊，變姓名自稱鴟夷子皮，耕於海畔。

根據上述的史實，我們可以簡要的作一結論，紀元前五世紀，在今之東海、黃海及渤海沿岸的越、吳、齊三國，平時懋遷，戰爭軍運，早已乘桴浮海而航行矣。

結　　語

根據上面的研究，最後對於太平洋及其沿岸帆筏的起源問題，因新資料的增加，似可作進一步的探討。對於簡陋之筏，似乎沒有理由可以懷疑，在任何地方，任何時間都能發明。但東亞和南美的帆筏，不僅栰之構造、駕駛，而連名稱都相同，乃就不能不設想他們可能是同源的了。

人類學家對航海帆栰的起源已有三說：非洲起源說，Hornell 氏曾對此加以駁斥(註1)，但最近 Heyerdahl 氏還說，筏可能自非洲因順風順濤，而達美洲熱帶(註2)。此說似乎值不得再多加討論了。

主張桴栰起源美洲的爲 Lothrop氏，他說：

> 木栰舖有甲板，上蓋艙篷，在 Andes 山之西很爲普遍。因此可以較可靠的假設，Jangada 起源於南美內陸。在實用上，Jangada 是產於新大陸的能載重而海運價值甚高的水運工具。他能載大量貨物，水手可以安居，同時發明使帆和插板，除稍遲笨外，在洋上航行頗爲便易。

他又說：

> Jangada 的航行方法，世界上除了臺灣，他處未見。從臺灣式樣，與他處大栰插板的裝置完全相同。倘沒有臺灣的例外，插板的發明，應屬於南美土著。至於下風板許多世紀以前已知，但是插板直至1870年歐洲和北美才開始採用(註3)。

(註1) Haddon and Hornell, 1938, p. 13.

(註2) Heyerdahl, 1952, p. 594.

(註3) Lothrop, 1932, pp. 237, 253.

但是研究太平洋船運的權威 Hornell 氏，則持反對意見，主張帆桅源於亞洲，由臺灣或海洋洲沿亞洲海岸經阿留申而至美洲。他說：

> 玻利尼西亞東部諸島和南美西岸遠隔重洋，又有西流而强力的海流，沿亞洲海岸傳播，比之橫渡太平洋的可能性較大(註1)。

Means 氏則反對此說，他的理由是：

> balsa 桅自東亞或南洋 (Oceania) 沿海岸而傳至南美西岸的問題，事實上祇證明傳播路線兩頭存在，而在中途尤其美洲漫長的海岸，絕對找不到桅的遺跡(註2)。

又 Lewis 氏亦贊同 Means 氏之說(註3)。而 Heyerdahl 氏之意且以臺灣之筏，可能是由南美橫渡大洋而來，他說：

> 美洲之外，祇有臺灣三人竹筏，早用插板航行。而古至何時迄無明證。他可能是或不是一種偶合，但臺灣適在太平洋的死角，處於 Marianas 羣島，南中國和菲列濱之間，太平洋的北赤道洋流，自中美橫渡大洋，至此而折向北流。我們對臺灣帆筏是土著(aboriginal)，或歐人傳入，或獨立發生等等，這是尚未解決的問題(註4)。

Heine-Geldern 氏則支持 Hornell 氏的理論，他說：

> 安南和臺灣的帆筏都用插板。此應特別注意，因爲秘魯 balsa 桅亦有插板，這似乎很可以來支持 Hornell 的假設：美洲的帆桅，是起源於亞洲的(註5)。

著者現根據中國古代的史實，贊成 Hornell 氏帆筏起源於亞洲，略言之：

1. 伏羲氏 (33rd cent. B.C.) 始乘桴。
2. 黃帝軒轅氏 (2697 B.C.) 變桴筏以造舟揖。
3. 少昊氏 (2597B.C.) 乘桴泛於海上。
4. 越王勾踐(5th cent. B. C.)使樓船卒二千八百人伐松柏以爲桴。
5. 孔子 (551—479B.C.) 欲之九夷，乘桴浮於海。

(註1) Hornell, 1931, p. 355.
(註2) Means, 1942, p. 20.
(註3) Lewis, 1947, p.13.
(註4) Heyerdahl, 1952, p. 593.
(註5) Heine-Geldern, 1952, p. 332.

6. 宋淳熙間(1174—1194 A. D.)臺灣土著"不駕舟揖，惟縛竹爲筏"。

以上各項事實，前三者雖是傳說，但後三者都是可靠的歷史，很可以之答覆 Lothrop, Means，Heyerdahl諸氏疑問。至於 Hornell 氏沿太平洋岸的傳播，著者不敢完全贊同，因爲帆筏航海，既安全，又重載，且能逆風航行，在紀元前，中國燕齊吳越的航海不僅在近海沿岸，早已能航行遠洋，如春秋時陰陽家鄒衍的大九州之說：史記卷七四：

> 中國外如赤縣神州者九，乃所謂九州也，於是有裨海環之。人民禽獸莫能相通者，如一區中者乃爲一州。如此者九，乃有大瀛海環其外，天地之際焉。

這種學說，必有所據，至少可表示中國人早在太平洋上航行，而得到的海洋地理知識，作者擬在另文詳論之。

FORMOSAN SEA-GOING RAFT AND ITS ORIGIN IN ANCIENT CHINA

(TRANSLATION)

LING SHUN-SHENG

INTRODUCTION

In the last decade there was a growing trend among Americanists to become interested in the basic problems of cultural history, i. e., the processes of the origin and growth of culture in general, in addition to the study of the peoples and cultures in their specialized areas.(1) For instance, in the meetings of the International Congress of Americanists held in 1949 at New York, over ten papers on the cultural connection between Asia and the pre-Columbian America were presented.(2) In 1951, when the 118th meeting of the American Association for the Advancement of Science was held at Philadelphia, Section H (Anthropology) devoted three days to the discussion of the problem of Asian and North American trans-Pacific contacts during which fourteen papers were read. Most of the papers represented the view that the cultural diffusion between Asia and America came not only by way of the Bering Strait but also across the Pacific and that "the multiplicity of Old World influences reached America in various periods and from different regions." Similar interests are to be found among the Oceanists as well. The 1948 Kon Tiki Expedition of Heyerdahl is another case in point. Heyerdahl has set forth the old theory of Joaguin Martinez de Zuñiga on the American derivation of the Polynesian, Micronesian, and the Philippine peoples and cultures and once more proposed that the Polynesians are descendants of the American Indians(3) — a theory strongly opposed by Heine-Geldern and other authorities.(4)

A number of evidently analogous cultural traits have been singled out of the primitive cultures in the Americas, the Pacific, and Asia. The theory that the American cultures were derived from, or at least profoundly influenced

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(1) Smith, 1953, p. 1.
(2) Heine-Geldern, 1950, pp. 350-352.
(3) Zuñiga, 1803, pp. 26-30.
(4) Heine-Geldern, 1952, pp. 314-362.

by, cultures in Asia should by now have been accepted by most people. However, there are still many Americanists who insist upon the uncompromising theory of cultural isolation of the New World. This, the author believes, results from their lack of acquaintance with the problems of Asian-American cultural relationships on the one hand, and on the other, their skepticism towards the ability of man to get across the Pacific before the time of Columbus. Merill, for instance, once pitied "the poor Buddhist missionary who had to make such an impossible voyage across the Pacific in times when boats were crude affairs and distinctly limited in size."(1)

The present author is especially interested in the theory of cultural diffusion in the Pacific. As a Chinese, he was able to find a number of parallels to the cultural characteristics pointed out by Americanists and Oceanists, in the prehistory, history, ethnology and folklore of China. These evidences compelled the author to place himself on the pro-side of the trans-Pacific contact theory. It is his hope that more students of ethnology will give more attention to the ancient maritime activities along coastal Asia. Should it be proved that the Asians did sail into the Ocean by rafts, deckrafts or double dugout-canoes before Christ, the Pacific was then no barrier to the communications between Asia, Oceania, and the Americas. Basing his views mainly on Chinese data, the author attempts to deal with the following two topics, "The Sea-going Raft in Present-day Formosa and Its Origin in Ancient China" and "The Sea-going Double Dugout-canoe and Deck-raft in Ancient China before Christ."

I. THE SEA-GOING RAFT IN FORMOSA

In the winter of 1955 and the spring of 1956, the author investigated the sea-going bamboo rafts in the following sea-ports of Formosa: Hsin-kang (新港) and Ta-wu (大武) in Tai-tung (臺東) Hsien, Fang-liao (枋寮) and Tung-kang (東港) in Ping-tung (屏東) Hsien, Hung-mao-kang (紅毛港) and Chia-ting (茄頂) in Kao-hsiung (高雄) Hsien, and An-ping (安平) in Tai-nan (臺南) Hsien. The rafts are built by fishermen, whose ancestors came from Southern Fukien about 300 years ago. They speak the Min-Nan (Southern Fukien) dialect. Besides fishing the rafts are also used for transporting goods along the coast.

There are two major classes of bamboo rafts in Formosa: those used in rivers (Pl. I: 1) and lakes (Pl. I: 2), and those used on the sea. The former,

(1) Merrill, 1950, p. 10.

used for transporting and fishing purposes on lakes and rivers, is propelled by paddles or poles, comparatively simply constructed, and mostly flat bottomed. The latter, used for working in the sea, propelled mainly by sail and, when occasion demands, by paddles instead, has a bow-like body and is comparatively deliberately constructed. Rafts of the latter class will be discussed here.

According to the *Annual Report of Taiwan Agriculture* for '1955, the fishing boats without mechanical power in Formosa amount to 21,541, of which 13,808 are bamboo rafts and the remaining one-third are plank boats. So far as, the author knows, the sea-going bamboo raft is more extensively used in Formosa than anywhere else in the world.

The sea-going bamboo raft in Formosa can be further divided into two kinds — those used along the coasts and those sailing on the high sea. Rafts used along the coasts are propelled by paddles only (Pl. I: 4) while those used for the high sea are propelled by both paddles and a sail, and can be called sailing rafts (Pl. I: 3). As the fisherman of the port of Chia-ting are noted for techniques of constructing and sailing the rafts, the author proposes to take a sailing raft of Chia-ting as an example of the following.

(I) *The Construction of the Sea-going Sailing Raft*

The construction of the sailing raft at Chia-ting (Pl. II) may be described under the following five headings: the body, the mast and sail, the paddles and helms, the center board, and the stone anchors.

1. **The body of the raft.**

There are three sets of raw material for composing the body of the raft. These are, in order of relative importance, bamboo (9 or 11 bamboo poles for each raft), timber (over 20 pieces, beside those for the mast, paddles, and helms), and split rattans (over 50 for each raft; each split rattan is 6 meters in length and about one centimeter in diameter). Two kinds of bamboos are used: the ***ma-chu*** (麻竹) and the ***tsu-chu*** (刺竹). ***Ma-chu*** is planted in the mountain regions of Tai-chung, Hsin-chu, (新竹) and Chang-hua (彰化) Hsiens in Central Formosa and transported to the various fishing ports for sale. Each pole measures over 6 meters in length and 40–70 cm. in circumference at the fifth point from the root, and costs sixty to two hundred New Taiwan Dollars. ***Tsu-chu*** is planted nearby and is much cheaper in price. Rattan is imported from East Taiwan and costs about 1.00 yuan per split.

Before being lashed together to form a raft the bamboo have to undergo two procedures: The outer skin has to be scraped off (Pl. III: 1) and the bamboo pole has to be shaped (Fig. 1). The first procedure is scraping which is employed in order (1) to lighten the bamboo which makes it easier to float, (2) to render the shaping and binding easier, (3) to lessen the danger of cracking under the sun heat, and (4) to make it not too slippery to walk on. The second procedure — the shaping — varies with different kinds of bamboos. For *ma-chu*, it consists of straightening the *ma-chu* pole (already softened by heating in a fire) by means of a lever and to bend the frontal end a little until a required arc has been formed.(1) For the *tsu-chu*, which is thick and hard and therefore difficult to shape, the required shape is achieved either by selecting a pole with a natural bend at the end or by attaching a section of shaped *ma-chu* to one extremity.

After the shaping procedure, the bamboo poles are arranged in parallell direction on a wooden shelf about eighty centimeters high. The root-ends are adjusted in a straight line (Pl. III: 2) while the other ends are left irregular (Pl. III: 3). Poles that are too short are made up with sections of *tsu-chu*. Both ends of the bamboo poles are usually closed naturally by the intersectional stop. A few, however, are open and must be closed with wooden wedges or *tsu-chu* sections, bound with rattan or bamboo splits, sealed with putty and smeared with *tung* (桐) seed oil to render them watertight. The arrangement of the bamboo poles is as follows: for a sailing raft usually nine or eleven poles are used. The central one is the thickest and the outermost two on both sides are thicker than the rest; the third or the fourth one from either side inward should be of *tsu-chu*. The bamboo poles, after having being shaped, are smeared with fish-fat or *tung*-seed oil for preservative purpose (recently crude petroleum is sometimes used). The fish-fat is prepared from the fat of sharks by the fisherman themselves; it is cheap in price but its results poor. The *tung*-seed oil, on the other hand, is effective but expensive. When the smear has dried, the bamboo poles are arranged in proper order on the shelf and two or three men, one or two on the shelf and one below it (Fig. 2), begin their binding work. The binding starts from the middle toward both ends and proceeds by lashing eight wooden sticks perpendicularly on the bamboo poles. Then small bamboo

(1) Kokubu, 1947, pp. 38-39.

splints are inserted between neighbouring poles and pads of matted bamboo sticks are placed on certain parts of the raft. Finally, a thinner bamboo pole is tied to the marginal pole at either side to serve as bulwark. The construction of the body of the raft has now been completed and the craftsmen who build the wooden parts of the raft take up the work.

2. The mast and sail.

The mast is in most cases made of the long straight cedar timber with a length of five to six meters. The lower end of it usually has a circumference of some 30–35 centimeters and is made oblong in crossection in order to fit into the mast-socket. On the mast head is carved a long groove for the passing of riggings and a bamboo loop is hung up through which the sail rope is passed. The mast-support (Pl. III: 4) is an important part of the bamboo raft. It is made of an oblong wooden block (50 × 30 × 22 cm), weighing forty or fifty kilogrammes. At the center of it, a square socket is cut out (10 cm-sidelength) into which the mast is inserted (Pl. III. 5). Through the holes made on both sides of the block, two wooden staffs, which are longer than the mast-support and are tied to the third and the fourth of the wooden stick, are lashed perpendicularly to the raft. The distance between these two wooden sticks is equal to the breadth of the mast-support.

The sail consists of six strips of coarse white canvas (each being 60 cm. in breadth) sewn together longitudinally with linen or cotton thread. The whole sail is about 4.5 meters in length and 3.4 meters in breadth. It is first dyed in betel-nut juice and then in pig's blood; after being dried it will be of a dark reddish-chocolate color. On the sail are attached transversely ten or a dozen of smooth and straight bamboo staffs (Pl. VI: 2). The uppermost one, to which is attached the sail rope, is made of a thick bamboo or wooden staff and the lowermost one is also fairly thick. The other eight or ten staffs are arranged at equal distance. Each transverse staff is sewn on the canvas with stitches ten or twenty centimeters apart from one another. By the aid of these transverse staffs the wind force is evenly distributed on the sail and the position of the sail is made controllable. The length of each transverse staff follows the width of the particular section of the sail to which the staff is attached. A string is tied on the end of each staff; the ends of the strings are then twisted to a thick rope by which the sailor controls the tension of the sail.

3. The paddles and helms.

Each raft is equipped with four rowing paddles and two helming paddles (Pl. IV: 2). The paddle is made of a block of cedar wood, round in the upper section and flat in the lower. On the top is a round handle. The length of it is over three meters and the maximum width of the blade is about 20 centimeters. Around the paddle at a point 40–60 cm., below the handle is wrapped the paddle protector which is composed of bamboo splits (20 or 30 cm. × 1 cm.) placed parallel around the paddle and wrapped at both ends with bamboo or rattan splints (Pl. III: 6). It protects the paddle while it is being rowed and friction with the paddle-posts occurs. The construction of the helming paddle is exactly like that of the rowing paddle except that it is shorter and is placed at the rear end of the raft.

The paddle-supports (20–30 cm. 10 cm. 15 cm.) (Pl. IV: 4) are usually made of *nan*-wood or other varieties of hardwood. At the center a socket carved out (about 2 or 3 cm. sided) for the paddle post. The paddle-post is about 20–30 cm. high, and has a groove on the top to fix the paddle-string. The supports for the paddles are attached to the bulwark with split-rattans and supported by a staff one end of which is inserted into the paddle-support while the other end is tied to a *ma-chu* pole of the raft. The support for the rowing paddle is higher than that for the helming paddle because heightening of the fulcrum increases the force of rowing, while lowering the support of the steering paddle, facilitates the direction-changing function of the helm.

4. The center board.

This is the most important structure for a high-sea going raft. Ordinarily there are six board-positions (Pl. IV: 1) and six boards may be used. The positions of these six boards are: two at the front, two in the center, and two in the rear; or in other words, there is a board at each of the following points: front-left, front-right, center-front, center-rear, rear-left, and rear-right. The center-front and center-rear boards are placed in the center of the raft and may be collectively called the center-board. Of these two, the center-rear board is the most important one. However, the actual number of the boards can be reduced to three: one board for the front-left, the front-right, and the center-front respectively, one for the center-rear position, and the other for the rear-left and the rear-right positions, because no more than 3 boards function at the same time. The center board is made of a block of camphor wood.

The center-rear board is 70–90 cm. in length and 50–80 cm. in width and is oblong in shape. To its upper edge are attached two strips of wood for handling and the lower edge is cut thin to facilitate the insertion. The front and the rear boards are of approximately half the size of the center-board. However, there is no strictly defined proportion of the sizes of the boards and sometimes the boards vary greatly in dimension due to the limitation of the raw material (Pl. IV: 3). Each of the two center-boards is inserted into the raft through a board-slit, which is a bamboo section with a slit tied at either side of the mast support just between two consecutive bamboo poles (Pl. IV: 5). The front and the rear boards are inserted directly between two neighboruing poles without the use of a board slit.

5. **The stone anchor.**

The anchor for the bamboo raft is composed of wooden sticks tied together to a hook with a heavy stone attached to it (Pl. V: 6). When dropped, the anchor sinks into the sand and mud of the beach due to the weight of the stone, and the raft is consequently held in position.

6. **Other Paraphernalia of the raft.**

Usually there are four other items with each raft: (1) a bucket with a nailed lid having a semi-lunar hole (Pl. V: 2); (2) net-sinkers made of pebbles the waist of which are grooved and bound with wirings (Pl. V: 1); (3) mat-pads for the nets: bamboo splint mats, oblong-shaped, and placed on the frontal part of the raft and used as pad for fishing nets (Pl. V: 3); (4) floating-lanterns attached to bamboo staffs (Pl. V: 4).

(II) *Techniques for Sailing the Raft*

The sailing raft in Formosa is primarily used for deep-sea fishing. Emphasis here is laid upon the description of the technique for sailing on the open sea. It requires an intricate combination of skill in handling the paddles, the helms, and the vertical boards. For a good sailor, the raft, though slower in speed, is much safer than a boat because it can readily adjust itself to any kind of weather conditions.

1. **Paddle-rowing.**

The sailing raft is propelled by paddle-rowing on the following occasions: sailing along the coast or between spots at short distance, or when a complete calm sets in, mid-way of a long-distance sailing, and finally to increase the speed when escaping from a coming storm. The steering paddles can also be used for rowing when occasion demands (Pl. V: 5).

2. Sailing.

The technique of sailing is influenced by two factors: the wind direction and the strength of the wind.

(1) Wind direction: A variety of wind directions may be confronted by the raft when it goes on the high sea. However, a proper orientation of the sail can always lead the wind force to act upon the sail in a parallel or nearly parallel direction to the course, no matter in which direction the wind blows. In other words, the sail is pushed by two wind directions only: the favourable wind, and the side wind, the latter including those blowing from either the left or the right side. A head wind may also be met with advantage by a proper orientation of the sail.

a. Favorable wind: Needless to say, this is the ideal wind direction for the raft-sailors (Pl. VII: 1).

b. Side wind: The direction of the wind and that of the intended course form an angle wider than 45° on either side of the raft. The direction of around 45° is still favorable (Pl. VII: 2). The direction of about 90° is not so favorable but is still controllable by orientation of the sail (Pl. VII: 3).

c. Head wind: When a head wind is confronted, the raft simply makes a 45° or 90° turn in a S-shaped course toward its destination (Pl. VII: 4 a. b. c.).

d. Orientation of the Sail: The orientation of the sail depends upon the wind direction. When the wind is favorable, the sail is maintained at a position perpendicular to the long axis of the raft. In case of a side wind or a strong head-wind, the sail must be properly orientated: the sail is put at the right side of the raft when the wind blows from the left, and *vise versa* (Pl. VII: 5).

(2) Wind grade: Two grades of wind are recognized by the Formosan fishermen: the "fifty per cent wind" and "eighty per cent wind". When the wind is up to "fifty per cent", the full sail may be used; when it exceeds "eighty per cent", it is too strong to be confronted by the sail at all. The so-called "fifty per cent" or "eighty per cent" is determined only according to the fishermen's personal experience and not clearly defined. There are seldom complete calms on the sea and therefore the sail can be used on nearly all occasions. Even when the wind is over "eighty per cent" in strength, the raft is still capable of being propelled with a sail hoisted to one half or one third of its length.

The half-sail is used, when the wind is too strong, or the returning raft

is entering port, or when it becames necessary to reduce speed midway. The full-sail is used, when the wind is of a moderate strength or the raft is getting out of the port. When the sail is fully lifted, the plane of the raft will form a sharp angle with the water level, and therefore the wind strength must be now and then carefully checked, otherwise the loads will fall away into the sea. The tension of the sail, whether fully or partly lifted, is always important. It is controlled by pulling or loosening the sail rope.

3. **Helming.**

The course of navigation is controlled by the helming paddle which is set on the raft in one of the 3 following ways: (a) two helming paddles each suspended by a post on the rear portion of the raft at either side (Pl. VI: 1); (b) two helming paddles each passing through a cord-ring on the rear portion of the raft at either sides (Pl. VI: 3); (c) one paddle placed in the middle of the rear portion of the raft (Fig. 3). Only one of the two paddles is used, when the raft is to change direction: using the left paddle when the sail is placed at the left side of the raft or using the right one when the sail is at the right side. To change the direction of the raft-head, the sailor turns the paddle to the side toward which the head is expected to turn (Pl. VII: 6 a. b. c. d.). When one paddle is working, the one at the other side may or may not be taken out of the water.

4. **The center board.**

The center board is the most important device for the sea-going of rafts. Its functions are to balance the body, to make the course steady, to reduce the gradient of the plane of the raft, and to avoid violent reeling and staggering.

The body of the raft is a plane floating on the surface of the water. Its center of gravity is somewhere in the plane itself. When the mast is mounted and the sail is hoisted, the weight of matters above the plane is much greater than the raft-body itself, a condition easily causing the raft to capsize. Therefore vertical boards are inserted at the front and rear of the mast-support and at either sides of the front and rear portions of the raft to lower the center of gravity and to cause a better balance (Pl. VIII: 2).

In the second place, the raft is "floating" on the water surface and is subject to shakings by the overwhelming water movement in all directions. When the vertical board is set in, the raft can better maintain its course by aid of the water's pressure on the board from both sides (Pl. VIII: 4).

When the sail is lifted fully or partly and the wind is blowing strongly, the vertical axis of the raft is liable to incline toward the weather side. Therefore the board is set in, in order to lower the center of gravity and the pressure of the water on the board thence produced can equilibrate most of the wind pressure on the sail. In this way both the gradient of the raft-body and the danger of capsizing are reduced to a minimum (Pl. VIII: 1).

Finally, the raft is so light and floatable that it is subject to reeling and staggering due to the up-and-down and to-and-fro movements of the water. The use of the board can cause the raft to rest on the surface of the sea more firmly because of the water pressure on both sides (Pl. VIII: 3).

As previously described, there are three to six vertical boards for each sailing raft. Their respective use may be described as follows.

The Center-board. The center-rear board should be set in position when the raft is starting to leave the harbor. The farther it goes the deeper the board should be inserted. When the full-sail is hoisted or when the wind is strong, the board should be lowered to its full length; when the half-sail is used, or when the wind is comparatively weak or the speed relatively low, half or one-third of the board may be used. In short, the length of the center-rear board should be now and then adjusted according to the changing weather conditions. When the wind is very strong, the center-front board should also be inserted in the same way as the center-rear board. When the raft is to change direction, two-third of the center-boards should be lifted in order to lessen the water pressure. They are lowered again to their original position, when the turn has been accomplished.

The Rear Board. The function of the rear board is similar to that of the center-board. When the sail is placed at the left side, the left rear board is inserted; when the sail is at the right side, the right board comes into use. Its function is to produce an anti-functional force from the water to counter balance the wind force on the sail (Pl. VIII: 5). When the raft is to turn it also must be taken out.

The Front Board. The front board is used only when there is head wind or when the wind is extremely strong. When the raft sails against the wind, the body usually forms a greater gradient than on other occasions and therefore the front board is inserted to counter balance the water pressure and to help to break the water confronted (Pl. VIII: 6). The sail and the front and rear boards are usually placed on the same side; the latter two are in

the same straight line. The three boards (the central, front, and rear), when used simultaneously, form the corners of a triangle (Fig. 5). But when the wind is extraordinarily strong, the front board of the side opposite to the sail and the rear board are used in order to balance the water pressure and reduce the speed. The three boards then form three points in an oblique line (Fig. 4).

There are as a rule two sailors for each raft. One of them takes charge of the mast, the sail and the center-board and is responsible for hoisting and lowering the sail, and for handling the ropes and inserting the center-board. The other takes charge of the helming paddle, the sail rope and the rear board and is responsible for directing the course of the raft, and the tension, size, and orientation of the sail. A perfect sailing of the raft on the high seas depends entirely upon the close cooperation of these two sailors. Sometimes there is an additional seaman, hence the derivation of the term, the "Three Men Raft of Formosa," as it is called by some western scholars. The third man engages in fishing and, when occasion demands, rows the paddles or takes charge of the front-board.

II. COMPARISON OF THE RAFTS OF PERU AND FORMOSA

The sailing raft of Formosa as described in the previous section is the most common kind at the present time. For sake of comparison, we should also give a brief description of the earlier data and the minor varieties of rafts in Formosa. The record of a Formosan long-distance sailing raft first appears in the *Liu-chiu chuan,* (琉球傳) vol. 250 of the *Sung History* as follows:

> The Liu-chiu kuo is to the east of Ch'uan-Chou. There is an island called P'eng-Hu (澎湖) which is at a sight-distance....Sometimes in the Period of Ch'un Hsi (淳熙) (1174–1189), several hundred Liu-chiu natives, led by their headman, suddenly arrived at Shui-Ao, (水澳) Wei-T'ou (圍頭) and other villages, killing and robbing....(They) did not sail by boat, but bound bamboo poles into rafts. When condition for them turned unfavorable, they put the rafts into the water then and sailed away.

In the vol. 8 of *Chu Luo Hsien Chih* (諸羅縣誌) (compiled in 1717), Ma Kui-yu (馬貴與) is quoted as saying in his book, *Chi Liu Ch'iu* (紀琉球):

> (The natives) do not sail by boat; they sail by bamboo raft which is capable of being folded like a windscreen.

The first illustrated description was made by a Japanese sailor, Hata

Sada-nori in 1803, of the sailing raft at Chio-po-ran (秀姑巒) on the east coast of Formosa[1] (Pl. IX: 2). He states:

> The "bamboo boat" is over four fathoms in length and a little over seven *Chihs* (Japanese unit of length) in width. Bulwarks of matted bamboo splits are set on the left, right, and rear sides. The sail is of matted bamboo splints. A platform of bamboo work on the rear part is the place for taking meals and resting. On the boat are two or three men doing fishing and other work.

It was called a bamboo boat because the bulwark was relatively high so that the craft looked like a "boat". As a matter of fact, it was constructed on the same "wash-through" principle as a raft, The platform on the rear and the sail of reeds or bamboo splints make it different from a modern raft on the western coast.

At the present-time, at Hung-mao-kang of Kao-hsiung Hsien and some other places on the west coast of Formosa, there is a kind of small sailing raft, (Pl. VI: 4) sailing along the coast and on the island seas. The body is composed of one *tsu-chu* pole and four *ma-chu* poles. Only one pair of rowing paddles is used. The most remarkable thing is its sprit sail. A thick bamboo pole is used for the mast; at a point one-third from its top, is attached one end of another thinner bamboo pole, the other end of which projects into the sky; this pole and the mast forming a triangle with the apex pointing downward. An oblong piece of canvas is attached to the mast on one side. The other corner of the opposite side is fastened to the upper end of the bamboo pole, which crosses the sail diagonally. Sail ropes are sewn on the upper and lower corners of the canvas on the same side. The full-sail is rectangular and the half-sail, when so used, forms a triangle.

Besides Formosa, in East Asia the sailing raft is also found in Vietnam. As shown in Pl. IX: 1 the raft is composed of bamboo poles,[2] two and sometimes three sails, one at the front and the other at the rear, are used. There are three vertical boards, one in front, one in the center, and one at the rear. The general form of the raft is similar to that of Formosa.

In the Pacific, although the raft is considered to have been the device for the Malayo-Polynesian migrations,[3] yet the early navigators and anthro-

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(1) Hata, 1803, p. 52.
(2) Claeys, 1942, pp. 17–28.
(3) Friederici, 1928. p. 29.

pologists paid much greater attention to the outrigger canoes than to the raft and consequently the records of rafts are extremely few. Only the wooden raft of Mangareva, as illustrated by Beechey can be used for comparison. Beechey states[1]: "No canoes are seen in Gambier islands, but rafts or katamarans are used instead..... They consist of the trunks of trees fastened together by rope and cross-beams: upon this a triangular sail is hoisted ...."

Turning to South America, there exist a score of written records and illustrations of the raft. The earliest picture of a raft in South America known to the author was drawn by Benzoni, an Italian travellor (Pl. XI: 1). He visited the Spanish Colonies, including Peru, in the years between 1540 and 1556. In 1565, he published a book, History of the New World[2], in which he presents a sketch of a raft composed of seven wooden logs. Seven sailors and a crude sail are seen on the raft.

Next to this is the sketch (Pl. XI: 2) of the raft by Spilbergen who met with it at Payta in Peru during his voyage round the world in 1614–1617. On the raft were five sailors, two of whom were taking care of the sail and the other three were sitting on the deck taking charge of the insertion of the center-board. On the deck were placed four water bottles and three polished stone-like objects (stone anchors). The raft was equipped with two triangular sails, one at the front and the other at the rear. This raft had been at sea for fishing already for two months and was sailing back when met by Spilbergen[3].

As late as the beginning of the eighteenth century, the *balsa* raft was still frequently met with along the coast of South America between Ecuador and around the 8 degree of South Latitude, including the Peruvian seashore. Two Spanish navy officers, Juan and Ulloa, made studies of the construction and sailing techniques of the balsa. As shown in (Pl. XI: 3) the raft is composed of nine balsa-wood logs, each measuring 75 or 90 feet in length and 20–24 feet in width[4].

About a century ago, Paris for the first time made a detailed study of the wooden raft of Peru. His investigations were carried out at Port Guayaguil

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(1) Beechey, 1831, p. 143.
(2) Benzoni, 1857, p. 242.; Heyerdahl, 1952, p. 528.
(3) Spilbergen, 1619, p. 93.
(4) Juan and Ulloa, 1760, p. 186.

and he illustrated the result in the sketch (Pl. XI: 4) reproduced here. The raft is about 80–90 ft. long and 23–30 ft. wide.

It should be added that in Brazil there existed a kind of sailing raft with a triangular sail (Pl. X: 1) and vertical boards. The sail was similar in shape to a reverted-triangle as the sails used in Polynesia and on some of the wooden rafts in modern Brazil.(1)

According to the eight sketches presented above, we are able to make a preliminary comparison of rafts for the region west from East Asia to the east of South America as follows:

Form of the Raft. The form of the raft depends to a considerable extent upon the raw material used for its construction. In South America, the central log of the wooden raft is the longest one and the length of the logs decreases toward both sides, resulting in a wooden raft with two pointed ends. In East Asia, because of the great elasticity of the bamboo and the possibility of shaping it, the raft's rear end is kept straight and regular while the front end bends upward, giving the raft a boat-like appearance. It is noteworthy that Benzoni's raft seems to be composed of curved logs so selected as to bend out of the water at the bow and thus comes fairly close(1) to the Formosan raft in form. As regards the size of the raft, it varies with the number of wooden logs or bamboo poles. In all its range the sailing raft is composed of 5, 7, 9, 11, or 13 wooden logs or bamboo poles, with 7 and especially 9 as the most common numbers.

Mast and sail. Two kinds of masts are seen in South America: the pole mast and the sheer mast. The latter term refers to the mast composed of two poles crossing at tops and forming a reverted-V. Large rafts are usually equipped with a sheer mast or sometimes with two or three pole masts. In Asia, the Formosan and Vietnamese rafts have ordinarily the pole mast, two or three of which are used for larger rafts. On the inland waterways of China south of the Yangtze, the long wooden raft (Pl. X:3) is equipped with a sheer mast, while the pole mast is used for the shorter and narrower bamboo raft (Pl. X:2).

The shape of the sail is either square (rectangular or trapezoidal), or triangular, or reverted triangular. All of these varieties are found in South America. The first and the third varieties are seen in Formosa and the third

(1) Hornell, 1946, p. 82.; Heyerdahl, 1952, p. 591.

one only in the Pacific. Considering the fact that sails of matted bamboo splits in Formosa and of reed-mats in South China are either square or rectangular, we would like to propose that the sail of the rectangular and the trapezoidal shape represents the more ancient type.

Helm and Paddle. For the raft, the paddle plays the rôle of a helm for the boat, which cannot be fixd to the raft because its bottom is a plane. Three varieties of the rowing paddle are in use for rafts of different sizes: single paddles for large rafts at either sides; double paddles are used for rafts of medium size and are pushed by the sailors in the middle of the raft; double-headed paddles are used for the small rafts and rowed on both sides alternately. The first and third varieties occur in South America and the second and third in Formosa. The double headed paddle even now prevails among the Ami Tribe on the Eastern coast of Formosa for rowing the small fishing raft. The general forms of the paddle, essentially similar with those of the natives of Formosa and South America, are shown in Fig. 6.

Center Board. The center board was called by the South American natives *Guara* and in Formosa is termed *tʃ'iam.* It has been used for raft-sailing in Formosa and Vietnam in East Asia and in Peru and Brazil in South America. The various forms are shown in Fig. 7. The length and width of the board vary with the size of the raft: long and narrow boards (in greater numbers) are employed for the rafts of bigger size which have high and thick decks sometimes composed of three layers of parallel logs (Pl. XI: 4). While large and broad boards are used for the Formosan raft yet its body of is thin and single-layered.

Among the rafts illustrated in the present paper, only those of Beechey and Benzoni show no indication of the use of the vertical board. This probably results from the fact that the board is taken out when the raft is ashore and is inserted deep below the body when the raft is sailing, and therefore was not depicted by these two authors. In the Pacific region, no use of the vertical board has been reported, but this fact does not exclude the use of the vertical board for the Pacific. As we know, rafts in Mangareva made frequent round trips between Mangareva and Rarotonga and without the vertical board long-distance navigation by raft is almost impossible[1]. As for the raft of Benzoni, although no boards are visible in his sketch, yet

(1) Heyerdahl, 1952, p. 593.

we have the following footnote by Rear Admiral W.H. Smith for the "balsa" in his 1857 translation of Benzoni's *History of the New Worlds* running as follows[1]:

> The larger balsas carry sails on masts resembling sheers; and they are steered by raising or lowering, as the occasion may require, some boards which enter vertically between the timbers at either end of this rude, but ingenious, floating vehicle.

Finally, to compare the techniques of navigation. For Formosa, they have been described above; for South America, Juan and Ulloa have stated:

> But the greatest singularity of this floating vehicle is, that it sails, tacks, and works as well in contrary winds as ships with a keel, and makes very little leeway. This advantage it derives from another method of steering than by a rudder; namely, by some boards, three or four yards in length, and half a yard in breadth, called guaras, which are placed vertically, both at the head and stern between the main beams, and by thrusting some of these deep in the water, and raising other, they bear away, luff up, tack, lay to, and perform all the other motions of a regular ship.[2]

Paris also says:

> For steering, there are boards called guaras, which are sunk vertically in the intervals between the middle logs. These are driven in to a greater or lesser degree, fore or after, in order to luff or go about. The rafts have no other methods for steering on the ocean,....[3]

From the preliminary comparisons made above of the construction and function of the sailing raft in East Asia and South America, we are able to state that the rafts in these two regions were derived from a common origin. This statement is further confirmed by a comparison of the terms for the raft, which will be dealt with in the following section.

III. TERMINOLOGY FOR THE RAFT IN SOUTH AMERICA, THE PACIFIC, AND CHINA

The raft on the western coast of South America is generally known as *balsa*, first reported by the Spanish sailor, Bartolomeo Ruiz. Toward the end of February, 1527, after he had passed Cape San Francisco, Ruis sighted near the equator a tall sail. As he drew near, he found it was a large raft,

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(1) Smyth, 1857, fn.; Heyerdahl, 1952, p. 528.
(2) Juan and Ulloa, 1748, p. 189.; Heyerdahl, 1952, p. 538.
(3) Paris, 1841, p. 148.

called *balsa* by the natives, consisting of a number of huge timbers of a light, porous wood, tightly lashed together with a frail flooring of reeds raised on them by way of a deck. Two masts, erected in the middle of the raft, sustained a large square-sail of cotton, while a rude kind of rudder and a movable keel, made of plank inserted between the logs, enabled the mariner to give a direction to the floating fabric which held on its course without the aid of paddles(1).

In his early voyage round the world between 1614 and 1617, Joris van Spilbergen made a brief call at Payta harbor, some 120 miles South of Tumbez in Peru. Spilbergen had then his fleet supplied with fish from an incoming Peruvian raft, which he described as "one of the savage's vessels, called *balsem*. Here they have fish aboard and they can sail swiftly with these vessels in the wind."(2)

Means, the noted historian of Peru, says: "the word *balsa* is neither Quechua nor Colla. It probably comes from one of the local tongues spoken around the Gulf of Guayaquil. Primarily, it indicates the *balsa* tree and its wood, meaning raft only by extension of the original meaning."(3) However, Cobo at the end of the sixteen century says:.... "such is what in these lands is called *balsa* timber, because one makes of them good balsa."(4) Accordingly Mean's statement is hardly right. It is stated by Heyerdahl that "the origin of the term *balsa* for rafts is somewhat obscure....we may note that *dalca* is the aboriginal term for 'boat' or 'canoe' on the coast of Chile; whereas *vaka* is a general term for 'boat' or 'canoe' in Polynesia."(5)

H. H. Brüning, the German engineer who resided in Peru from 1875 through 1925 and is believed by Heyerdahl to be the last witness of the existence in Peru of the now extinct balsa raft(6), mentions that in the Peruvian harbors of Pimentel, San José and Sechura, the native fishermen made small rafts, *balsillas*, of balsa logs broken and discarded from the larger rafts.

It may at the same time be mentioned that in South America the balsa raft was also called *jangadas*(7). Lothrop writes: "Rafts with raised platforms,

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(1) Murphy, 1941, p. 7.; Prescott, 1847, p. 223.
(2) Spilbergen, 1619, p. 83.; Heyerdahl, 1952, p. 530.
(3) Means, 1942, p. 19.
(4) Cobo, 1653, p. 1.
(5) Heyerdahl, 1952, p. 529.
(6) Heyerdahl, 1952, p. 544.
(7) Paris, 1841, p. 148.

often carrying small shelters, are widely employed across the Andes, so that it seems safe to assume that the *jangadas* originated in the interior."(1)

Let us turn to the terms for rafts in Oceania. Among the Morioris on the island of Chatham, some 400 miles east of New Zealand, was found the real deep-water vessel, called *waka-pahi* or *pepe*, "measuring up to fifty feet over all, but was built on the very same wash-through principle."(2) J. M. Brown is quoted by Skinner as saying: "Their (the Morioris') *waka-pata* (*waka pahi*) remind me of the balsas or buoyant rafts of the Peruvian coast. On Lake Titicaca, I saw canoes made of reeds of much the same type (i. e. wash-through) as with the Moriori."(3)

On Easter Island, the raft is called *pora*. Métraux writes: "The Easter Islanders used rafts (*pora*) made of bulrush mats, rolled into big, conical bundles."(4)

"The *pahi*, or 'raft boat', of Tahiti," writes Enock, "Somewhat resembles the balsa of Peru, it is said."(5)

It is stated by Heyerdahl that "the natives of the Tuamotu group immediately distinguished the Kon-Tiki balsa raft as a *pae-pae*, telling its crew that such crafts were well known to their ancestors....The raftsmen of Mangareva also referred to their rafts as *pae-pae*...In Tahiti, too, *pae-pae* is the word for rafts in general. Throughout Polynesia *pae-pae* appears in the various dialects, meaning either 'raft', 'flooring', 'platform', 'to place in a row', 'to lay in order', or also 'to float', 'to drift', 'to go to leeward'"(6)

It is clear that the rafts in the Pacific are most commonly designated by two terms, *waka* or *vaka* and *paepae* or *pahi*, both of which may refer to the boat as well as to the raft. Taking this as his starting-point, the author has studied the terminology for rafts in China and is greatly surprised at the similarity of the facts he meets here with what he learned about the same subject for America and Oceania.

The Chinese characters designating raft found throughout the literature are given below:

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(1) Lothrop, 1932, p. 253.
(2) Shand, 1871, p. 354.; 1911, p. 86.; Heyerdahl, 1952, p. 581.
(3) Skinner, 1923, p. 119.
(4) Métraux, 1940, p. 208.
(5) Enock, 1912, p. 279.
(6) Heyerdahl, 1952, p. 584.

1. *fang* 方, *Han-Kuang* (漢廣) in *Shih-Ching* (詩經): "The river is so wide that one is hardly able to get across with the *fang* 方." Mao's *commentary*:" *fang* 方, means raft."

2. *fang* 舫, *Shih-Yen* (釋言) in *Erh-Yah* (爾雅): "*fang* 舫, means raft "Sun's *commentary*: "To put rectangular timbers on the water to make rafts.

3. *hung* 潢, *Shih-Shui* (釋水) in *Kuang-Yah* (廣雅): "*hung* 潢, means raft".

4. *fu* 泭, *Shih-Shui* (釋水) in *Erh-Yah* (爾雅): "The commoners ride on *fu* 泭." Kuo's *commentary*: "To bind timbers together to get across a river." *Ch'i-Yü* (齊語) in *Kuo-Yü* (國語): "The timbers bound together are called 泭." *Hsi-Wang* (惜往) in *Chiu-Chang* (九章) of *Chiu-Ts'ih* (楚詞): "Riding on a 泭 to get down the river." Wang Yih's *commentary*: "The bamboo or timbers bound together are called *fu* 泭. It is called 泭 by the Ch'u (楚) People and called *fa* 橃 by the Ch'in (秦) People."

5. *fu* 桴, *Kung-Yie-Ch'ang* (公冶長) in *Lun-Yü* (論語): "Riding on a *fu* 桴 to drift on the sea." Ma Jung's (馬融) *commentary*: "It designate the bamboo and timbers bound together; the smaller one are called *fu*桴. "*Ch'i-Yü* in *Kuo-Yü*: "Riding on a 桴 to cross a river." Wei's *commentary*: "The timbers bound together is called 泭, the small ones of which are called *fu* 桴." *Shuo-Shan-Hsiün* (說山訓) in *Huai-Nan-Tze* (淮南子): "Riding on a vehicle to foot on Yueh; riding on a 桴 to enter Hu."

6. *fu* 栿, *Ch'ing-Chung-Chia-P'ien* (輕量甲篇) in *Kuan-Tze* (管子): "No to bind the *fu* 栿 at summer."

7. *fu* 筏, *Shih-Shui* in *Kuang-Yah*: "*fu* 筏, means raft."

8. *fu* 筏, *Shih-Wen* (釋文)": *fu* 泭, Kuo pronounces 孚 *fu*, also written in another character 筏."

9. *fa* 筏. Section 9 of *Fang-Yen* (方言): "*p'ai* 簰, means 筏 (raft); is the common term in Ch'in and Chin"

10. *fa* 栰, *Lun-Yü*: "Riding on a 桴 to drift on the sea." Ma Jung's *commentary*: "It designates the bamboo and timbers bound together; the bigger ones are called *fa* 栰"

11. *fa* 橃, *Commentary* to *Chiu-Chang* of *Ch'u-ts'ih*: "*fu*泭, called *fa* 橃 by the Ch'in People." *Shuo-Wen* (說文): "橃, big boats in the sea." *Yü Pien's commentary*: "Big boats in the sea, or the *fu* 栿"

12. *p'ai* 簰, Sec. 9 of *Fang-Yen*: "泭, means *p'ai* 簰." *Shih-Shui* of *Kuang-Yah*: "*p'a*i 簰, means raft."

13. p'*ai* 筏, *Ch'in-P'eng-Chuan* (岑彭傳) in *Hou-Han-Shu*: "(He) leads thousands

of people riding on the *fang p'ai* 枋筏 to get across the river barrier." *Commentary*: "枋筏 is made of bamboo or timbers, floating on the water." *Teng-Hsiün-Chuan* (鄧訓傳) in the same book: "To sew leathers into boats, which are put on the *p'ai* 筏 to cross the river." *Commentary: "p'ai* 筏, timber rafts."
14. *p'ai* 簰, *Yih-Ch'ieh-Ching-Yin-Yih* (一切經音義), "*p'ai* 簰 is called *fa* 筏 in the Dialect: called 簰 by the southerners and 筏 the northerners." *Ching-Tien-Shih-Wen* (經典釋文): "簰; also called 簰."
15. *p'ai* 排, *T'ang-Yun* (唐韻):" *p'ai* means raft."

The fifteen characters listed above vary in the form due to time and space distinctions. According to the pronounciation however, they may be grouped into four classes:

(1) 方, 舫, 潢. 方 and 舫 appeared early and are pronounced in the same way: Modern Sound: *fang*; Middle Ancient Sound: *p̣iwang*; Ancient Sound: *p̣iwang*. 潢 occurred later; Modern Sound: *hung, heng;* Middle Ancient Sound: *rwang*; Ancient Sound: *g'wăng*.

(2) 浮, 桴, 枎, 箙, 箙. These five characters are grouped together; the first three are more ancient. 浮 and 枎: Modern Sound: *fu*; Middle Ancient Sound: *p'i̯u*; Ancient Sound: *p'i̯u*. 桴 Modern Sound: *fu*; Middle Ancient Sound: *p'i̯u*; Ancient Sound: *p'i̯ug*.

(3) 栰, 筏, 橃. Modern Sound: *fa*; Middle Ancient Sound: *b'i̯wat*; Ancient Sound: *b'iwât*. 橃 appeared very late.

(4) 簰, 簰, 筏, 排. Modern Sound: *p'ai*; Ancient Sound: *b'ai*.

In conclusion, there were four words each designating a kind of raft and being represented by one of the following four characters: 桴, 筏, 方, 簰. In Ancient China, these four kinds of raft, each represented by one or more than one characters, distinguished either the size (e. g. Nos. 5 and 10 of the characters), or the raw material (No. 4), or refer to different areas (Nos. 4, 9, and 14).

Since the boat was invented in or introduced into China, terms for rafts have been extended to designate boats as well. *Shou-Wen* (說文): "方, means the parallell connected boats;" also: "舫, means the *fang chou* 方舟 (double-canoes)." *Erh-Yah. Commentary* by Li Hsiün (李巡): "The two boats connected together is called the 方舟." *Fang-Yen*: "The 方舟 is called the 潢;" also: "The boat is either called 舟 or called 舫 in the areas east of T'ung Kuan (潼關)." It is then clear that the 方, 舫, and 潢, originally terms for rafts, were later also used as terms for double canoes. 橃, as mentioned above, was a

term for rafts; but in *Shuo-Wen* it is defined as "the big boat in the sea."

Being not a linguist, the author does not dare to draw further conclusions. According to the data brought up so far, at least the following two hypotheses seem permissible:

(a) Rafts in South America are called *balsa*. It is very similar to the Korean term *palson*, which is used for a fishing raft in South Korea[1], and *balsa* is also close to the ancient Chinese term 筏, *b'i̯wat*.

(b) Terms for rafts in Polynesia, as: *vaka, waka, pae-pae, poe-poe, pora, pepe, pahi*, etc. seem to have derived from the chinese terms 桴 *fa, b'i̯wat*; 橃 *fa, pi̯wat*; and 簰 *p'ai, b'ai*

The argument between Heyerdahl and Heine-Gėldern[2] whether the terms *vaka, paepae*, and *pahi* designate originally raft or the boat can probably be settled according to the above statements. The terms *vaka* and *paepae* were originally terms for rafts before the present era, and have been used to designate also the boat from the Han Dynasty onward. It seems proper to assume that the term *balsa* in South America and *vaka* and *paepae* in Oceania originated very probably from China. The chronology of their diffusion may be as follows: the *balsa* and *vaka* are the earliest to have diffused, followed by the *paepae*. If the two had different places of origin, the term *vaka* probably originated in the area north of the Yangtze and *paepae* south of it.

Finally, a few words should be added. The author has recently studied the terminology for rafts, the papers by Friederici[3] and Hornell[4] concerning the distribution and diffusion of the terms for boats and rafts in Oceania. It is assumed by both of them that terms for boats and rafts in Oceania originated from either the Indo-Chinese Pennisular or the Indonesian Archipelago. The author, basing his view on the study presented above, is of the opinion that for the purpose of determining the origin and distribution of terms for boats and rafts in Oceania, the hundreds of boat and raft terms recorded in Chinese literature must be considered as the most ancient and the most important data.

IV. THE ORIGIN OF THE RAFT IN CHINA AND ITS USE AS A SEAFARING VESSEL IN THE PRE-CHRISTIAN ERA.

According to the traditional history, the raft was used in China since

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(1) Nishimura, 1922, p. 59.
(2) Heyerdahl, 1952, p. 23.; Heine-Geldern, 1952, pp. 332-334.
(3) Friederici, 1928. pp. 27-51.
(4) Hornell, 1931, pp. 70-72.

very old days. In *Wu-Yuan* (物原), Lo-Hsin (羅欣) says:

> Sui Jen (燧人) got across the river by riding on gourds; Fu Hsi (伏羲) began to ride on the raft (桴); Hsiüan Yüan (軒轅) invented the boat.

In *Huang Ti P'ien* (黃帝篇), vol. 1 of *Shih-Yih-chi* (拾遺記) by Wang Chia (王嘉), it is said (that) Hsiüan Yuan converted the raft into the boat.
In *P'i P'ien* (稗編), the following is said:

> It is said in *Shih-Yih-Chi* (拾遺記) that Emperor Hsiüan converted the raft into the boat. Accordingly, it is proper to say that the raft was used to get across a river before the invention of the boat.

Wang Chia belonged to the age of the end of the Western Chin Dynasty. What he describes in *Shih-Yih-Chi* about an invention centuries older than himself can not of course be taken as convincing. However, it is presumably true that the Chinese used the raft to cross rivers before the invention of the boat.
It is stated ın *Shih-Pen* (世本) that:

> In old days the boat was invented by observing the fallen leaves. The boat was invented by Kung-ku (共鼓) and Huo-ti (貨狄). (*Commentary*: Kung-ku and Huo-ti, two officers of Huang Ti or the Yellow Emperor)

In *Chou-Yih* (周易) the following is said:

> To dig out a block of wood is to make a boat; to sharpen a stick of wood is to make an oar. The boat and oar are made to conquer the water barriers and for fishing.

Accordingly, the earliest method in China of boat-making was "to dig out a block of wood." In the time of the Yellow Emporor, the "jade" is said to have been used to make tools and weapons, as stated in the vol. 11 of *Yüeh-Chüeh-Shiu* (越絕書):

> Feng Hu Tzə (風胡子) says: "in the time of Huang Ti, the jade was used to make weapons, to cut down the trees for buildings, and to dig the soil."

The boat was invented during the times of the Yellow Emporor possibly because of a progress of tools. However, constructing a boat is not so easy and convenient as to make a raft by binding bamboo or timbers together. It has to be assumed therefore that the raft and the boat have coexisted for a long while and that the even more primitive water transportation devices such as the gourd and the reed rafts also occured side by side with the log-raft and boat. It is stated in Chuang Tze (莊子) that:

> To make a boat of five *shihs*, big gourds for floating in the river and

lake.

In Ho Kuang (河廣) of *Shih-Ching* (詩經) it is said that

Who says the river is too wide to cross?

Riding on a bundle of reeds one is able to get across.

The Formosan aborigines used gourds, rafts, and boats side by side as their water transportation devices. In *Fan-She-Ts'ai-Feng-T'u-K'ao* (番社采風圖考), Liu Shih Ch'i (六十七) says:

When the autumn rain falls suddenly and the streams are filled up with water, they with gourds around the waist get across the streams as easily and as swiftly as riding on a horse.

There are tens of great rivers in Taiwan.... When the official headmen of natives want to cross the rivers, they ride on bamboo rafts which are supported and progressed by swimming natives.

The Shui-Sha-Lien She (水沙連社) at Changhua is backed by mountains and encircled by a river which is several *lis* wide and of unknown depth. When the Chinese come for trade, the aborigines transport them with a dugout canoe, called *banga*.

The raft in China has not only been used since very ancient times but was also employed for sea-faring in old days. In *Shao-Hao-P'ien* (少昊篇), the vol. 1 of *Shih-Yih-Chi* the following information is given:

The mother of Shao Hao (少昊) was called Huang Eh (皇娥) who weaved during the night in the palace and went sight seeing in the daytime by riding on a raft. She had passed the rivers in Ch'iüng Sang (窮桑) and Ts'ang mang (滄茫). At that time there was a clever boy of extraordinary appearance called the Son of Pai Ti (白帝子)....The Son of Pai Ti and Huang Eh sailed into the sea. They made the mast of cassia's stem and the sail of smoked straws; they carved the jade into a bird and put it on the head of mast, saying that the bird knows the weather.... The present day vane is a survival of this....

In the Ch'un Ch'iu Period (711–529 B.C.) the raft was still used for sea-faring in China. In *Kung-Yieh-Ch'ang* of *Lun-Yü*, Confucius says that "When my 'way' is impossible to be put in to practice, I shall ride on a raft drifting into the sea." In *Shus-Wen-Chieh-Tze* (說文解字) the following words are said:

Confucius says: when my 'way' is impossible to be put in to practice I shall go to the Nine Barbarians by drifting into the sea on a raft,

Confucius did have reason to say so!

The Nine Barbarians, according to the *Tung-Yih Chuan* (東夷傳), consisted of: the T'ien-Yih (畎夷), the Yü-Yih (于夷), the Fang-Yih (方夷), the Huang-Yih (黃夷), the Pai-Yih (白夷), the Ch'ih Yih (赤夷), the Hsiüan-Yih (玄夷), the Feng-Yih(風夷), and theYang-Yih(陽夷), all of whom were oversea barbarians and were accessible by drifting on a raft. In Vol. 8 of *Yüeh-Chüsh-Shu* (越絕書) it is stated: "Kou Chien (勾踐).... When he first arrived at Lang Yah (瑯琊) he ordered the 2800 *lou-chuan* men to cut down trees to build rafts." Having exterminated Wu, Kou Chien, the King of Yüeh, changed his capital to Lang Yah which was then an extremely important harbor in the South and North communication of China by sea before the Christain Era. The old and the new communications became increasingly frequent after that time and consequently Kou Chien had given the order to his 2800 sailors to cut down trees to build more rafts. According to the information given above, the present author considers it fairly proper to say that *fu* (桴) is a term for rafts used for ordinary sea-faring vessels which when used for fighting were called by another term, *lou chuan* (樓船).

For that reason the Chinese have been able to enter the sea since very early times, so the sea-route was opened quite early. In so old a document as *Yü Kung* (禹貢) it has already been said:

> (Between) the Huai and the sea is Yang-Chou (揚州)....He went along the Kiang (江) and the sea and reached the Huai (淮) and the Si (泗).

In the Ch'un-Ch'iu Period, the oversea communications from the three coastal kingdoms, Ch'i, (齊) Wu, (吳) and Yüeh, (越) were actually recorded.

In *Tso-Chuan* (左傳) under the *4th Year of Hsi Kung* (僖公):

> Yuan Tao T'u (轅濤塗) told Cheng Shen Hou (鄭申侯): If the army goes by the route between Cheng (鄭) and Ch'en (陳), the country will greatly suffer. It seems more proper to go along the East, showing our force to the Eastern Yih, and to come back by sea.

And under the *10th Year of Ai-Kung* (哀公):

> Hsu Ch'eng (徐承) led the navy to arrive at Ch'i from the sea. The Ch'i people defeated them. Then the Wu's navy came back.

In *Yüeh-Yü* (越語) of *Kuo-Yü*:

> The Yüeh's march into Wu was: Fan Li (范蠡) and Ku Yung (古庸), led the force to arrive in the Huai valley from the sea to cut off the Wu's transportation route.

Also in *Kuo-Yü*:

Fan Li went to Ch'i by drifting by the sea route. He changed his name into Ti-Yih-Tzu-P'i (鴟夷子皮) and farmed by the sea-shore.

On the basis of the data presented so far, we may summarize our conclusions thus: as early as the 5th century B. C., in the three kingdoms Yüeh, Wu, and Ch'i, on the coast of the East Sea, the Yellow Sea, and the Chihli Bay, the communications in ordinary days and transportations during war time had been by the sea route by way of rafts.

CONCLUSIONS

The new data presented above permit conclusions as to the origin of the raft on the coasts of the Pacific and on the islands. We surely do not doubt the possibility, of a parallel invention of such a simple device as the raft in diverse regions. However, because the construction, navigating techniques, and even the terms for the rafts in Southeast Asia, the Pacific and South America are similar to each other we are compelled to say that the rafts in these areas are probably of a common origin.

As regards the question of the regions where the raft may have originated, anthropologists have provided several possible answers. The first and the least noteworthy one is the African origin theory, which has already been dismissed by Hornell(1). However, recently Heyerdahl once more proposes that the idea if not the craft itself in one of its manifestations might have reached tropical America like the gourd and the cotton with a favorable wind and current from the African side of the Atlantic(2). It does not seems worthwhile to argue this statement any more here.

Another theory is that of the American Origin supported by Lothrop. He states(3):

> Rafts with raised platforms, often carrying small shelters, are widely employed across the Andes, so that it seems safe to assume that the jangada originated in the interior. In actual practice, however, the jangada was much the most seaworthy and capable vessel produced in the New World. It was able to carry a large cargo and to house its crew in comfort, and, at the same time, the invention of sails and center-boards made it possible to propel and manoeuvre with ease in the open ocean

(1) Haddon and Hornell, 1938, p. 13.
(2) Heyerdahl, 1952, p. 594.
(3) Lothrop, 1932, pp. 253, 231.

an otherwise clumsy raft.

and,

> From the foregoing description it will be seen that the jangada was steered in a manner found in no other part of the world, except it be Formosa, from which island come models of large sailing rafts with center-board fittings, apparently homologous. Were it not for this exception the invention of the center-board might be attributed to the natives of South America. While leeboards have been known for many centuries, the center-board has been employed in Europe and North America only since about 1870.

This statement is again argued by Hornell, who initiates the theory of the Asiatic Origin of the raft and assumes a diffusional route, i. e. northward along the Asiatic eastward along the America. He says[1]:

> In view of the distance between the eastern islands of Polynesia and the coast of America and of the adverse westerly run and great strength of the current which a canoe would have to meet on the passage eastwards, the probabilities are apparently in favour of coastwise diffusion from Asia in very remote times, rather than by the ocean highway.

Hornell's theory is opposed by Means. Means is of the opinion that[2]:

> This thesis of a coastwise diffusion of the balsa type of craft from eastern Asia and Oceania into western South America is vitiated by the fact that the balsa type appears along the indicated route only at the extremities thereof, absolutely no traces of it appearing in the immense intervening stretches of the American west coast.

And his argument is approved by Lewis[3]. Heyerdahl who led the Kon-Tiki Expedition also disagrees with Hornell and proposes the idea that the Formosan raft was derived from South America! His argument is[4]:

> Outside America the center-board seems to have been historically observed in aboriginal navigation only on the three-men bamboo rafts of Formosa. Its antiquity there is apparently not verified. It may or may not be a coincidence, but Formosa is located in the same deadlock corner of the Pacific, between the Mariannas, South China and the Philippines, where

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(1) Hornell, 1931, p. 355.
(2) Means, 1942, p. 20.
(3) Lewis, 1947, p. 13.
(4) Heyerdahl, 1952, p. 593.

the North Equatorial Current turns north after its broad sweep westwards from Central America. Whether we are dealing with aboriginal or post-European diffusion, or with independent invention, is a question not yet settled.

On the other hand, Hornell's theory is backed up by Heine-Geldern, who states[1]:

> Both these Viet-namese and Formosan sailing rafts are fitted out with center-boards. This is particularly remarkable because the Peruvian balsa rafts too had center-boards. It would seem to lend considerable support to Hornell's suggestion that the American sailing rafts may be derived from Asia.

On the basis of the historical records in Ancient China, the present author stands by Hornell and for Heine-Geldern. i. e., the Asiatic Origin of the raft in the Pacific[2]. As described in the last section, the raft in China is traceable to the latter half of the forty centuries B. C. of the tranditional date.

1. Fu Hsi Shih (伏羲氏) (33rd century B. C.): "beginning to ride on rafts."
2. Hsiuan Yuan Shih (軒轅氏) or the Yellow Emperor (2697 B. C.): "converted the raft into the boat."
3. Shao Hao Shih (少昊氏) (2597 B. C.): "Riding on a raft and drifting on the sea."
4. Kou Chien, (勾踐) the king of Yueh (5th century B. C.): "ordered 2800 sailors to cut down cedar trees to build rafts."
5. Confucius (551–479 B. C.): "wanted to reside amongst the Nine Barbarians and to go by drifting on a raft."
6. In the Period of Ch'un Hsi (淳熙) (1174–1194 A. D.) of the Sung Dynasty: "The Formosan aborigines do not ride on boats; they bind the bamboo poles into rafts."

Listed above are historical records from ancient Chinese literature. Although the former three are of a more or less legendary in nature, the latter three are historically highly trustworthy. They can well answer the questions set forth by Lothrops, Means, and Heyerdahl. On the other hand, the present author in accordance with Heine-Geldern does not agree with Hornell's theory of the Asiatic coastal diffusional route for the raft. The raft on the open sea

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(1) Heine-Geldern, 1952, p. 332.
(2) Heine-Geldern, 1954, p 408.

is both comparatively safe and capable of transporting heavy loads and sailing against the wind. As early as the first century B. C, the raft in the kingdoms of Yen, Ch'i, Wu and Yüeh of coastal China sailed not only along the coast but also on the high seas. In the Ch'un Ch'iu Period, Tsou Yen (鄒衍) of Ch'i proposed his Greater Nine Continents Theory as follows (from Shih-Chi, vol. 74):

> Outside the Middle kingdom, there are nine continents (九州) (Ch'ih-Hsien, Shen-Chou (赤縣神州) etc.). They are the so-called "Nine Continents." They are encircled by the sea. A continent is like a district in which the people and animals are isolated from the outside. There are nine in total like this. Finally a vast sea goes round. This is the margin of the heaven and the earth.

A theory like this must have been backed up by some kind of geographical observation. Is it possible that it indicates part of the geographic knowledge acquired by the Chinese as sailors of the Pacific?

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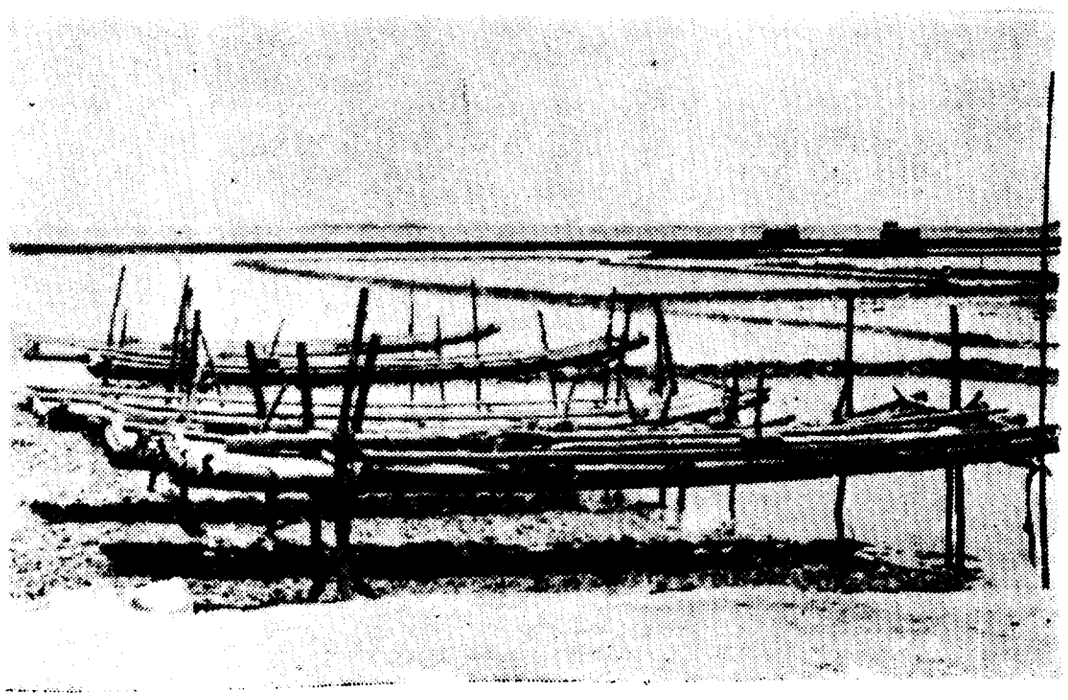
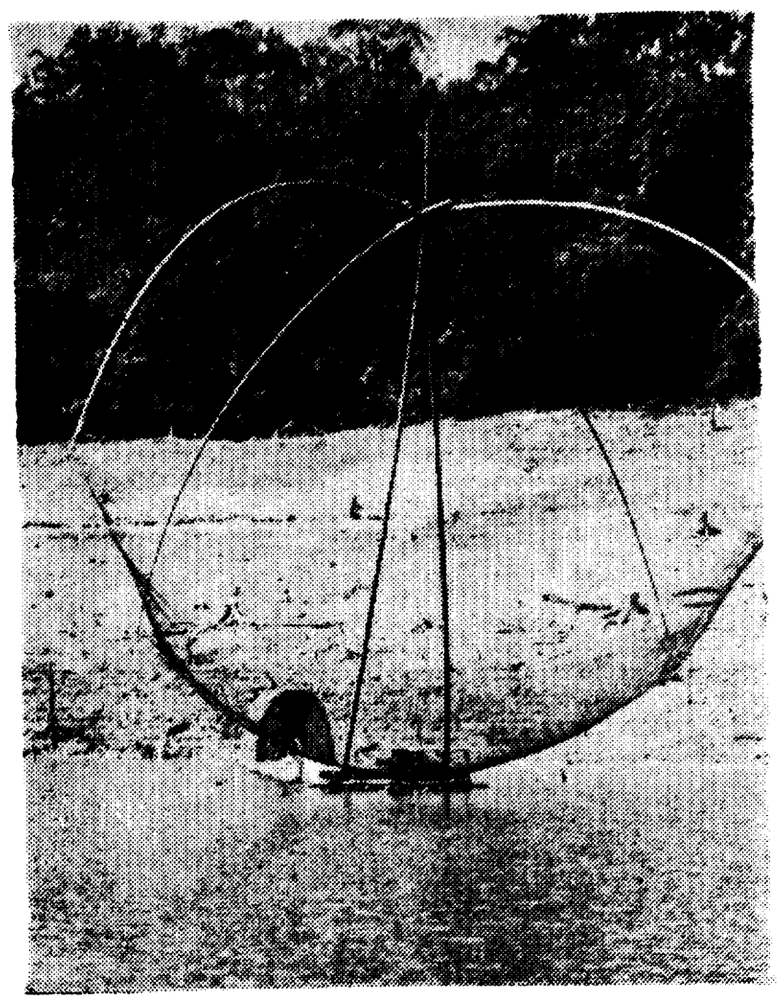
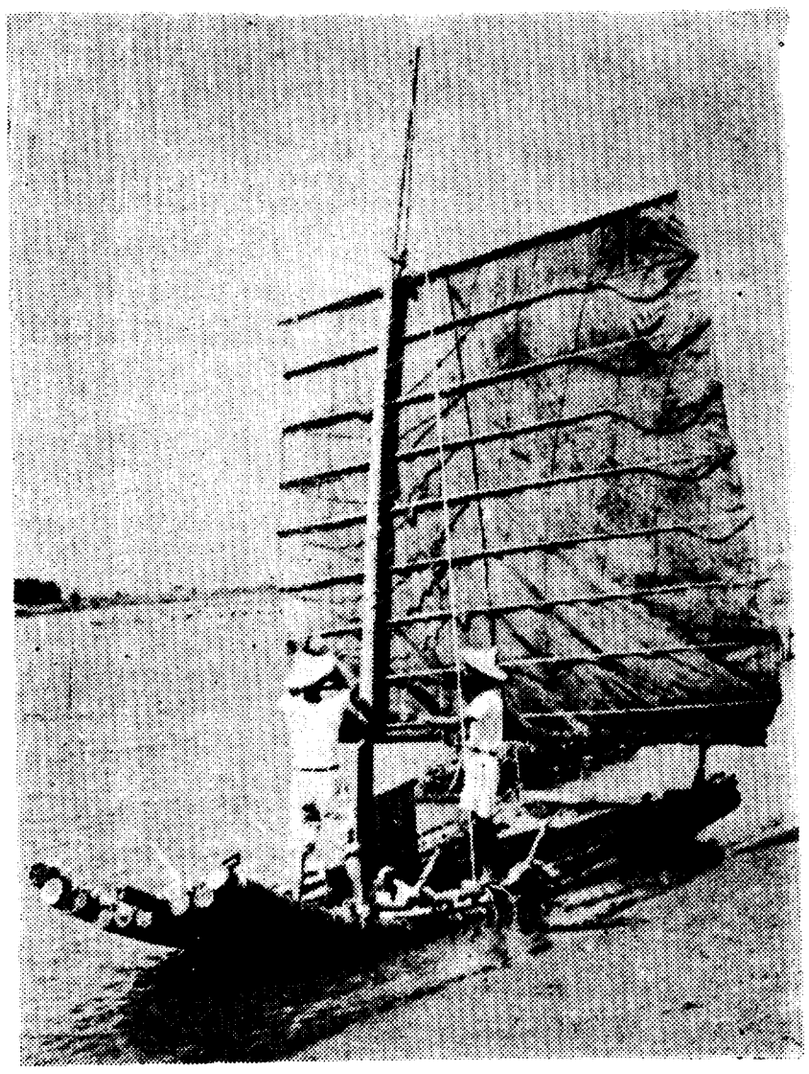


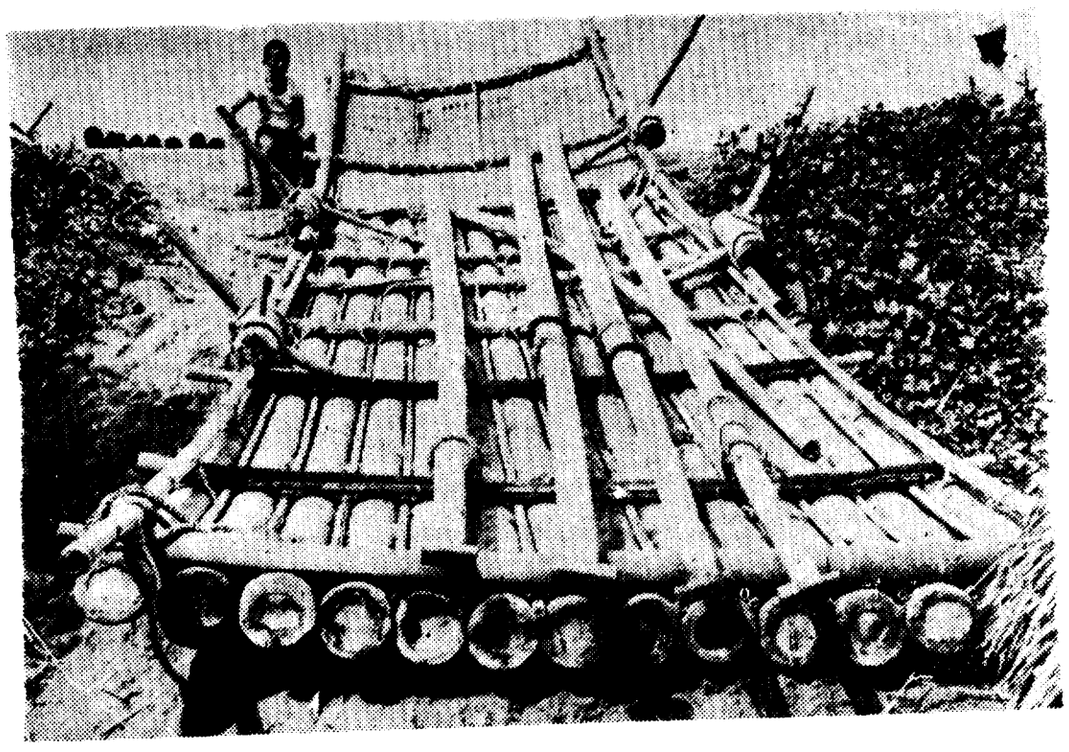
1. 河川竹筏
River-raft.



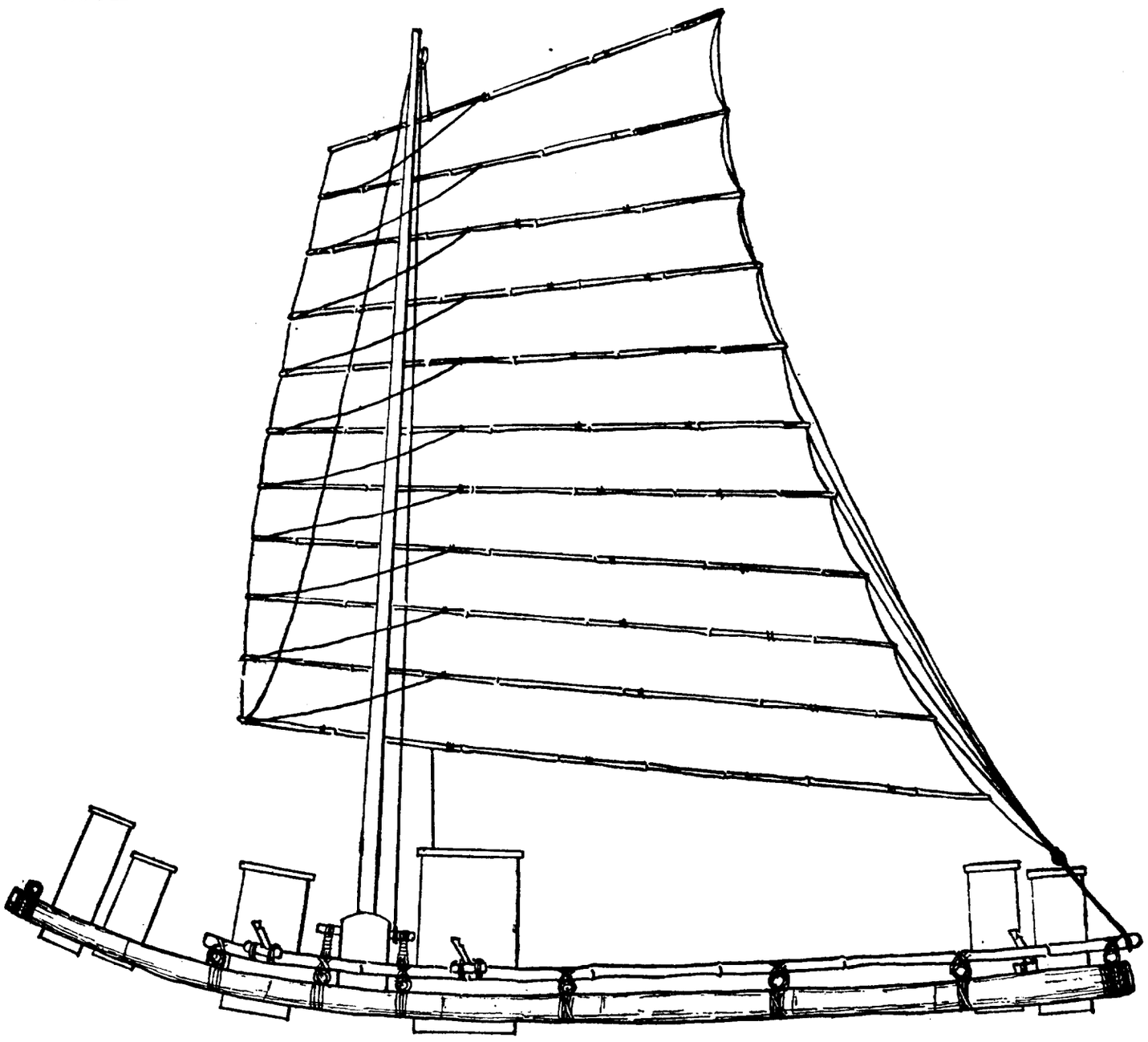
2. 湖泊竹筏
Lake-raft.



3. 海上帆筏
Seagoing raft with sail.



4. 海上划筏
Seagoing raft propelled by paddles.



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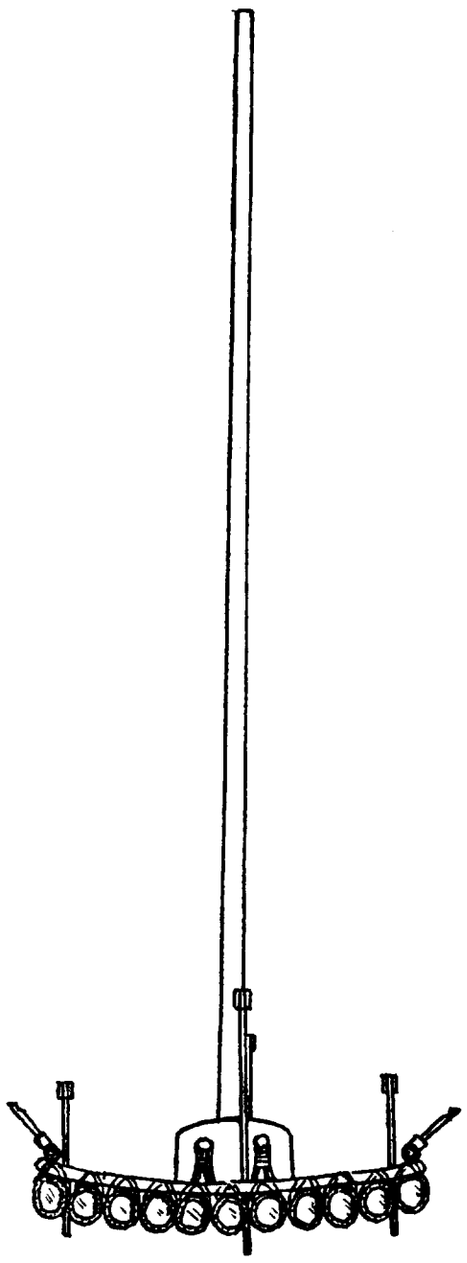

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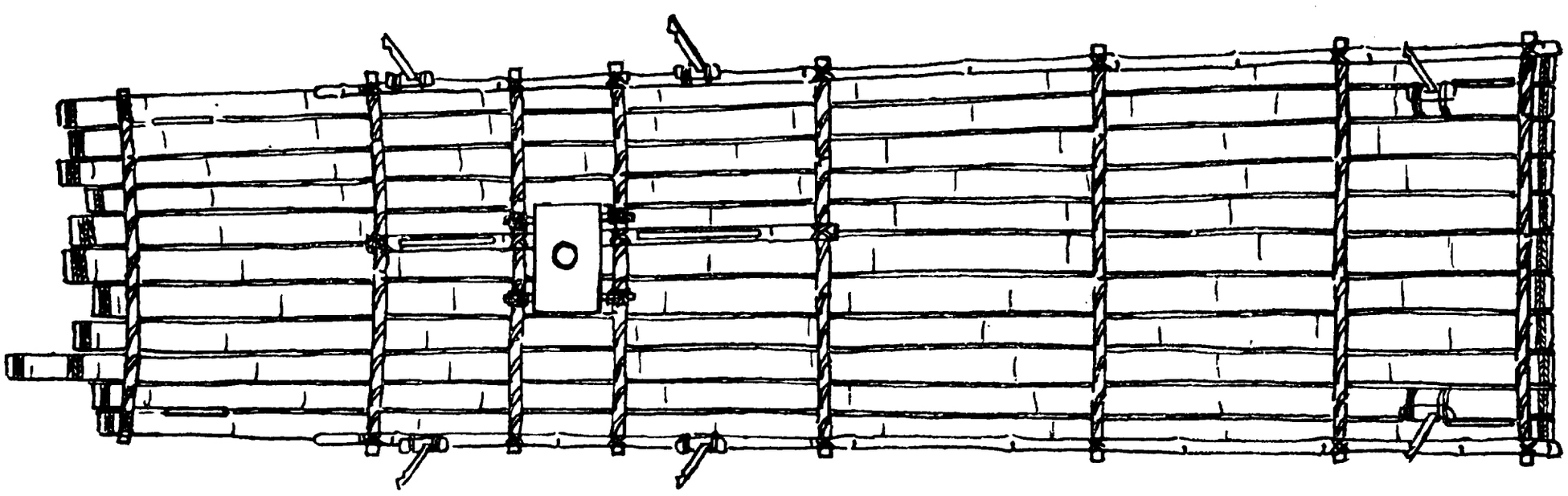

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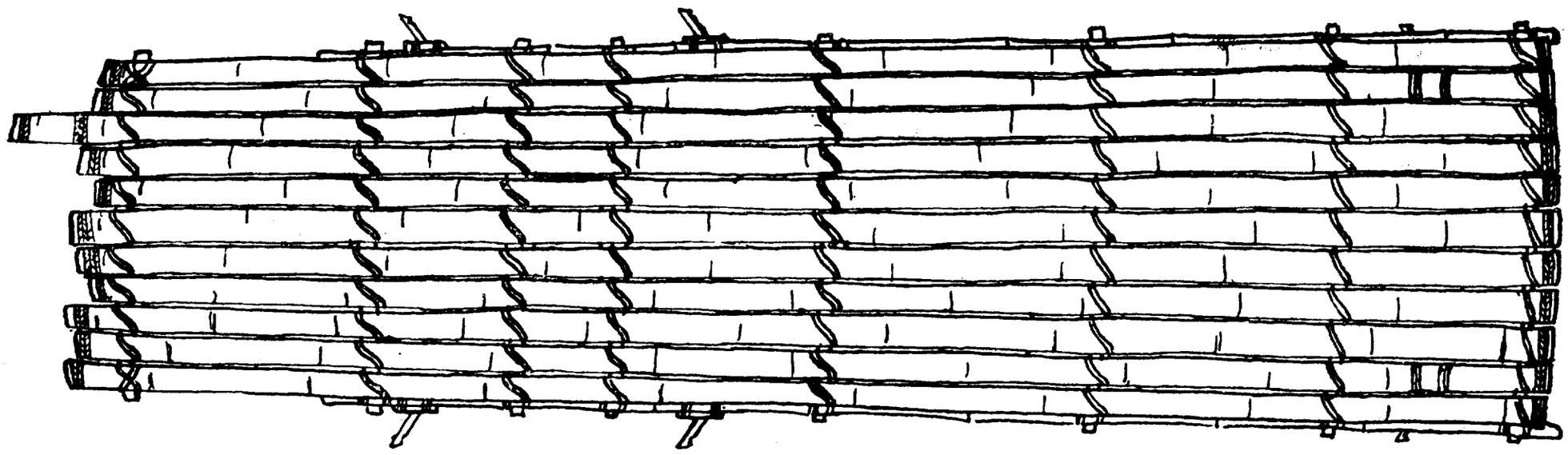


4

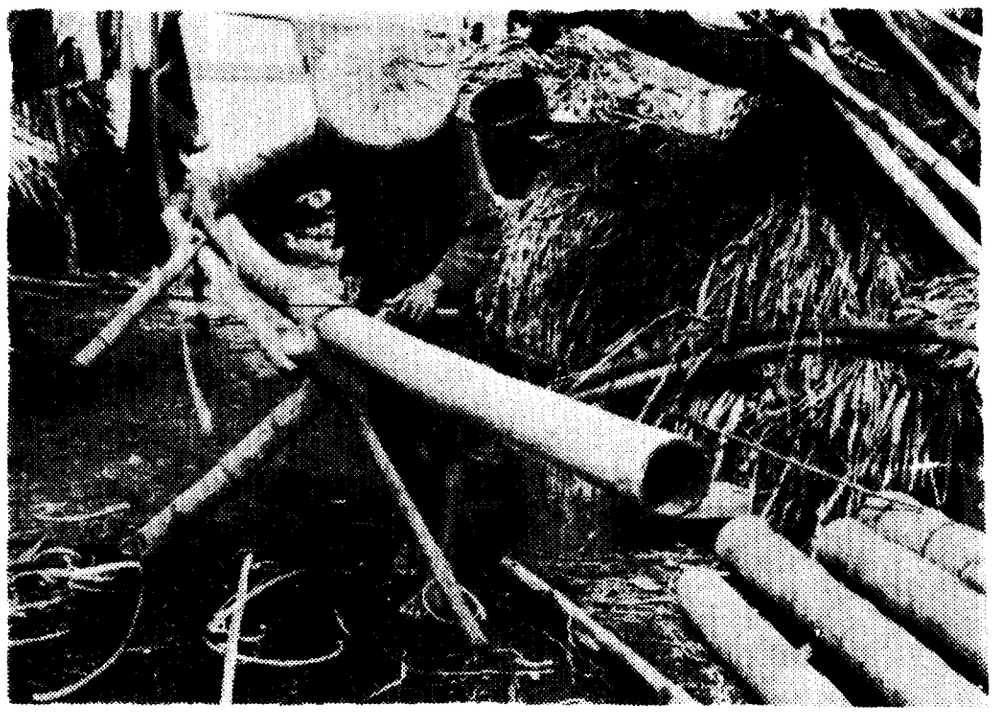
茄萣帆筏

1. 側視全貌　　2. 前視　　3. 俯視筏面　　4. 筏底

全長7.4公尺，筏頭寬1.6公尺，筏尾寬2.0公尺，桅高5.4公尺，帆長4.5公尺，帆寬3.4公尺，中插板0.8×0.7公尺，前後插板0.5×0.4公尺，由蔴竹十根，刺竹一根組成。

Seagoing raft of Chia-ting, consisting of 11 bamboo poles.

1. Side view.　　2. Front view.　　3. Top view.　　4. Bottom of the raft.



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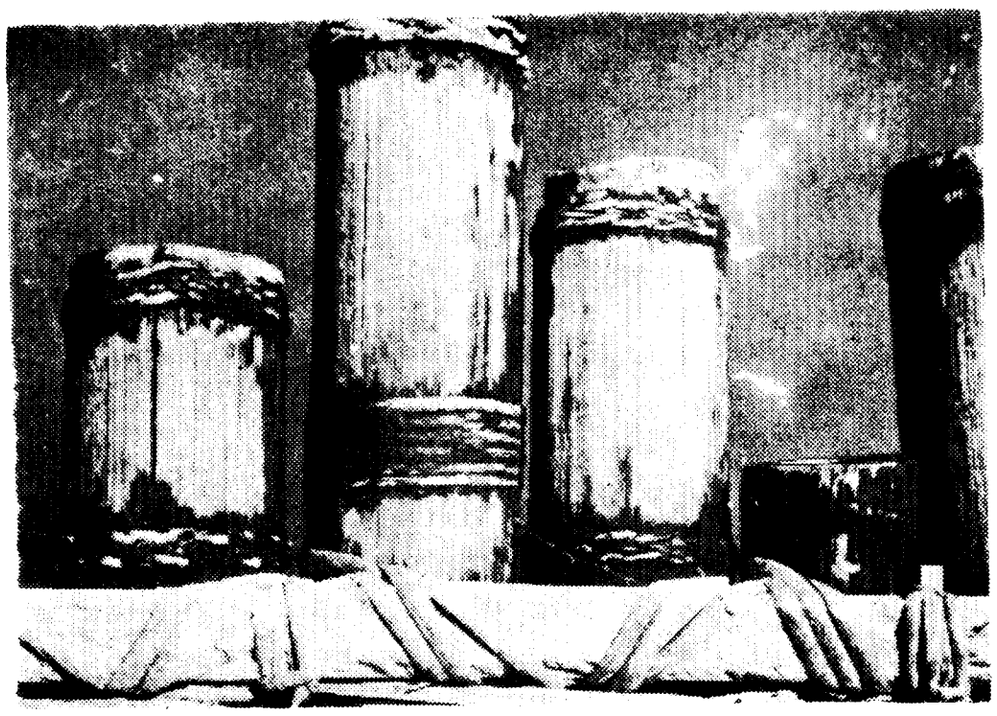

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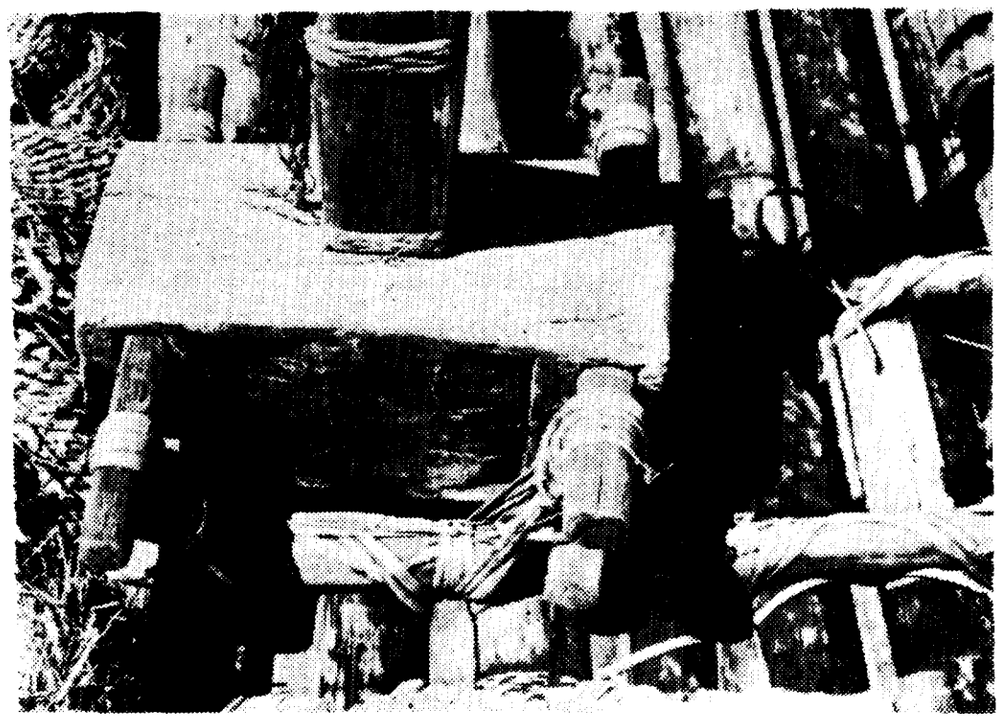

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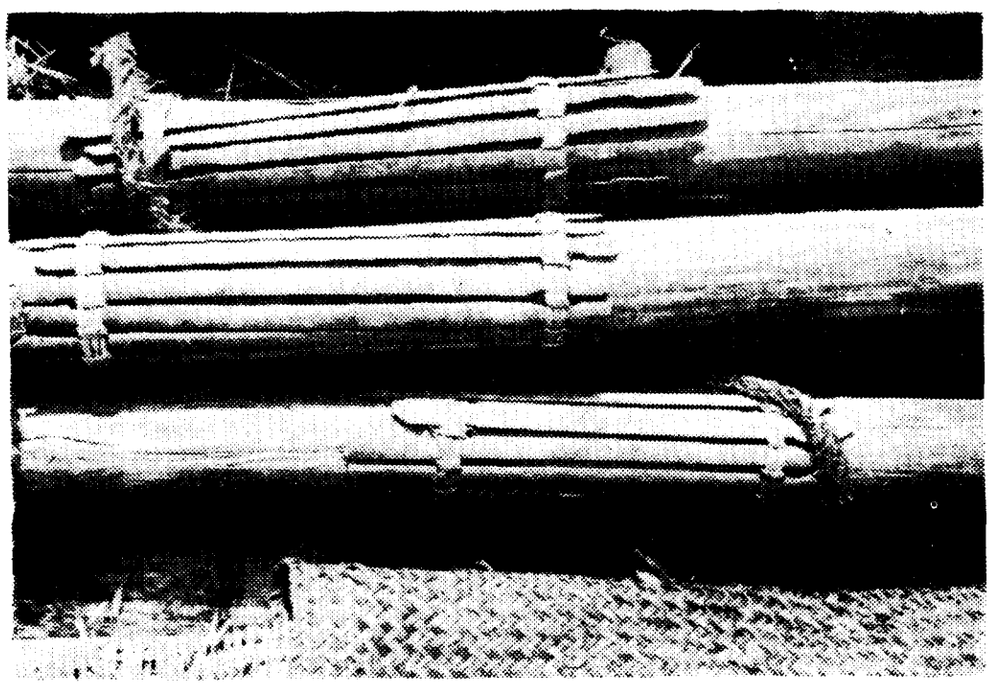
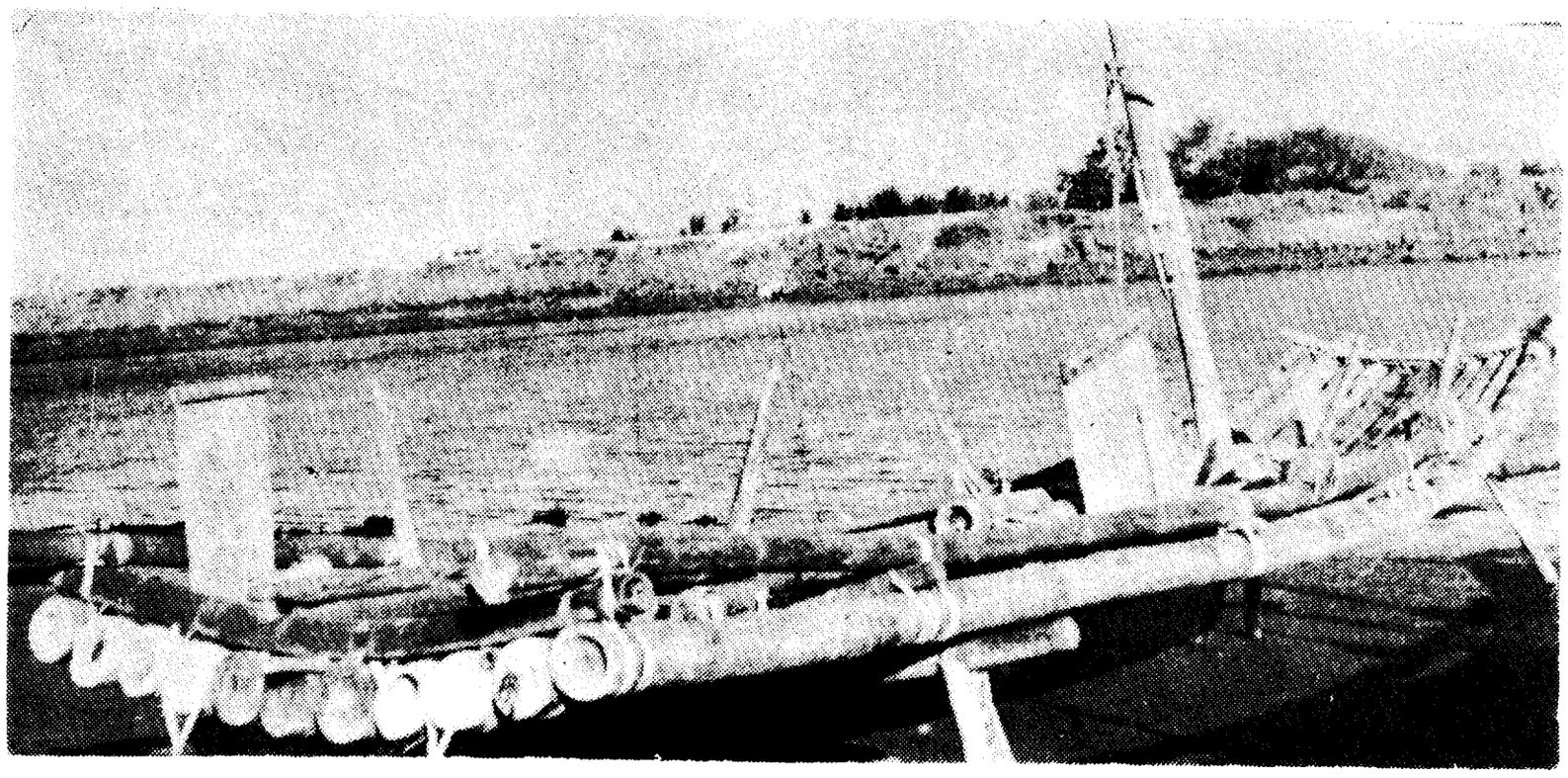


6

1. 刮去竹青　2. 筏尾取齊　3. 筏頭參差　4. 桅桿座　5. 桅座方洞　6. 護槳

1. Scraping off the outer layer of the bamboo.
2. The poles forming the stern are cut into equal length.
3. At the bow the ends of the poles are left protruding.
4. Socket with mast inserted.
5. The hole in the socket for the mast.
6. The paddles are protected by split bamboo.



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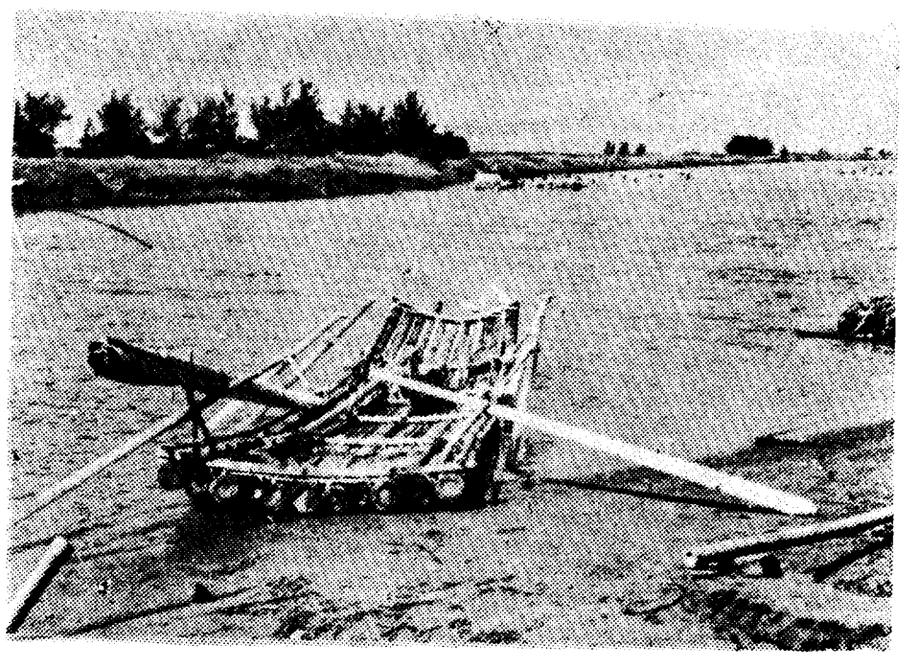

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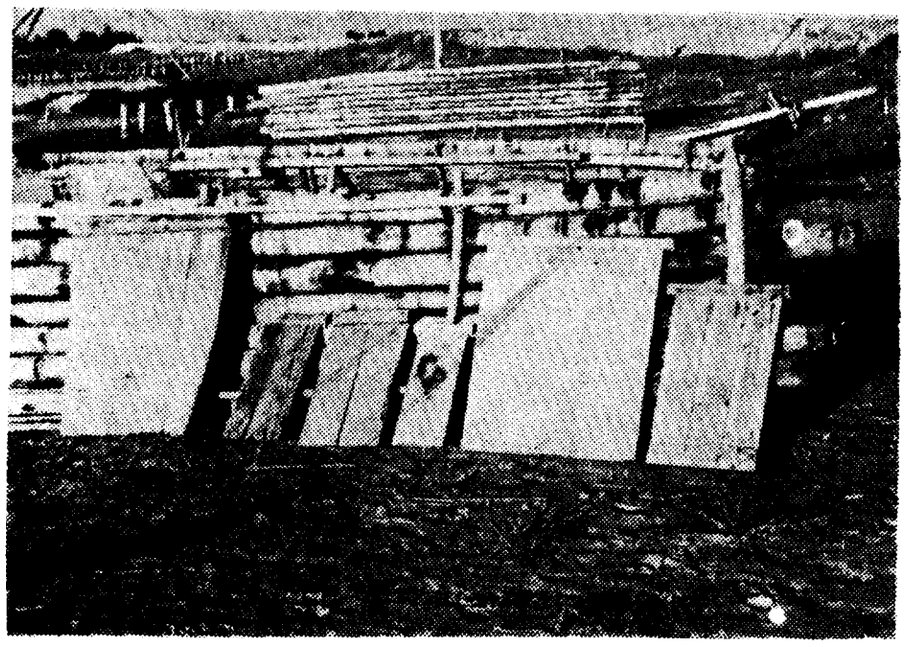

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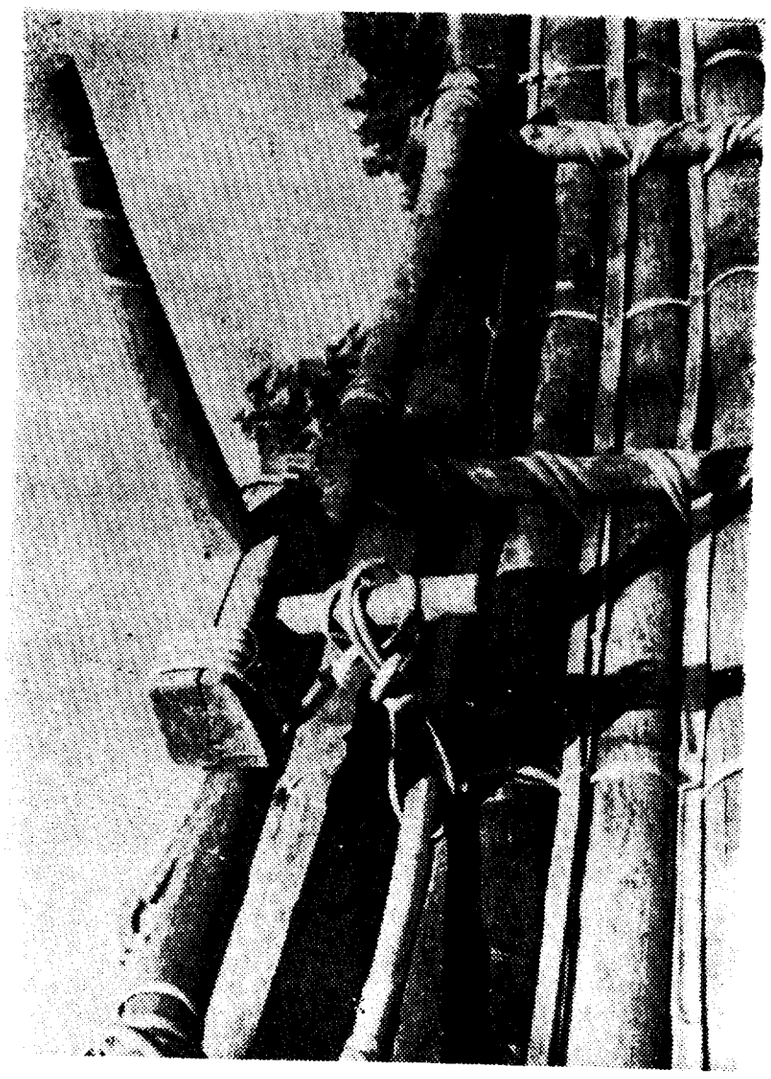

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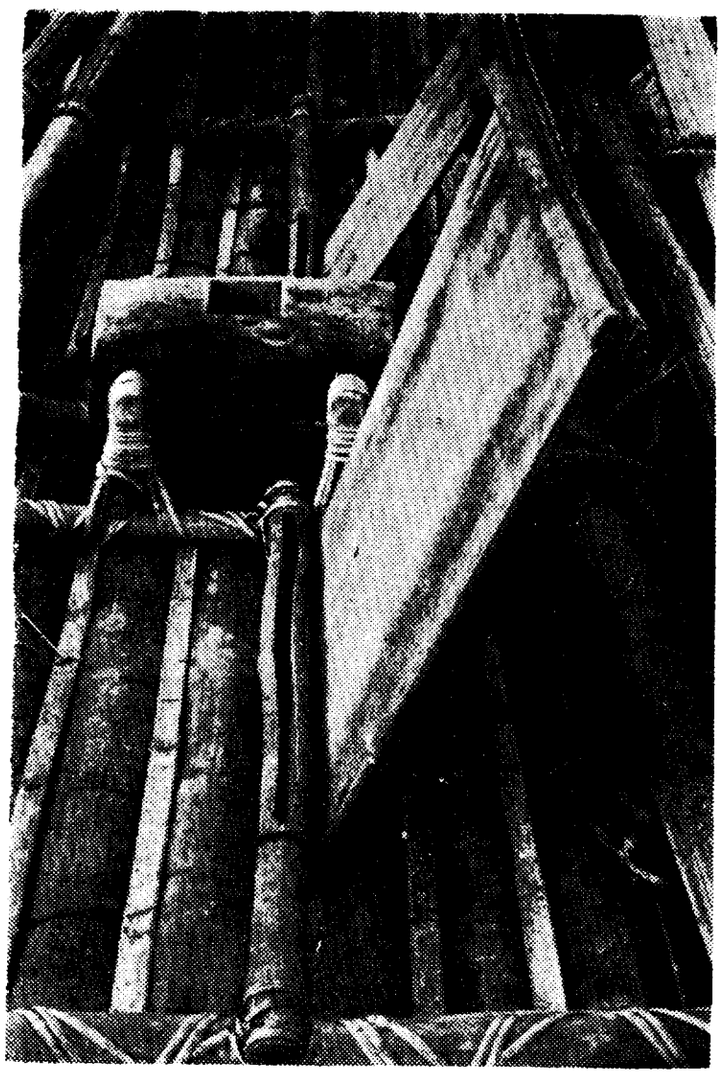
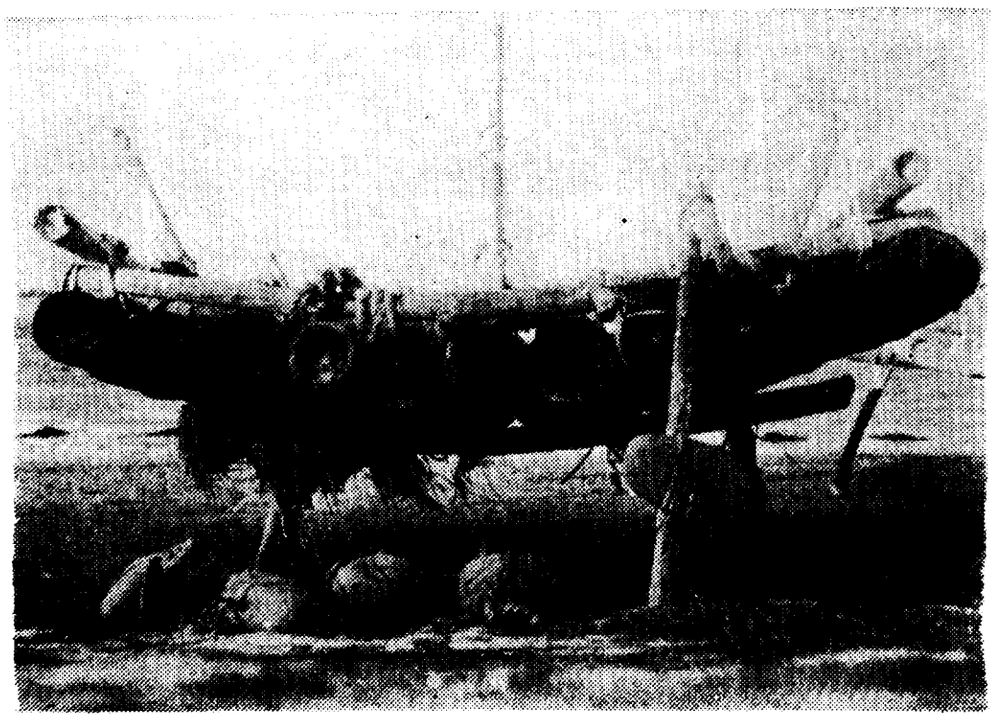


5

1. 插板位置　2. 划槳及舵槳　3. 大小插板　4. 槳座　5. 插板槽

1. Position of center-board at bow and stern.
2. Rudder and paddles in position.
3. Center-boards of different sizes.
4. Post for fastening the paddle.
5. Slit for insertion of the center-board.



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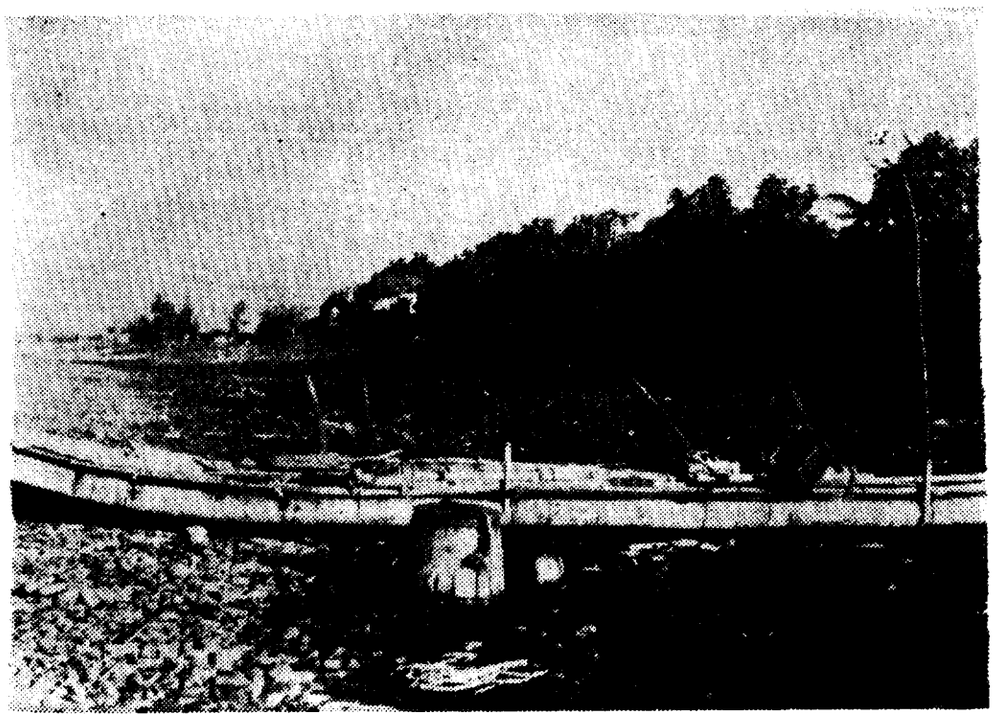

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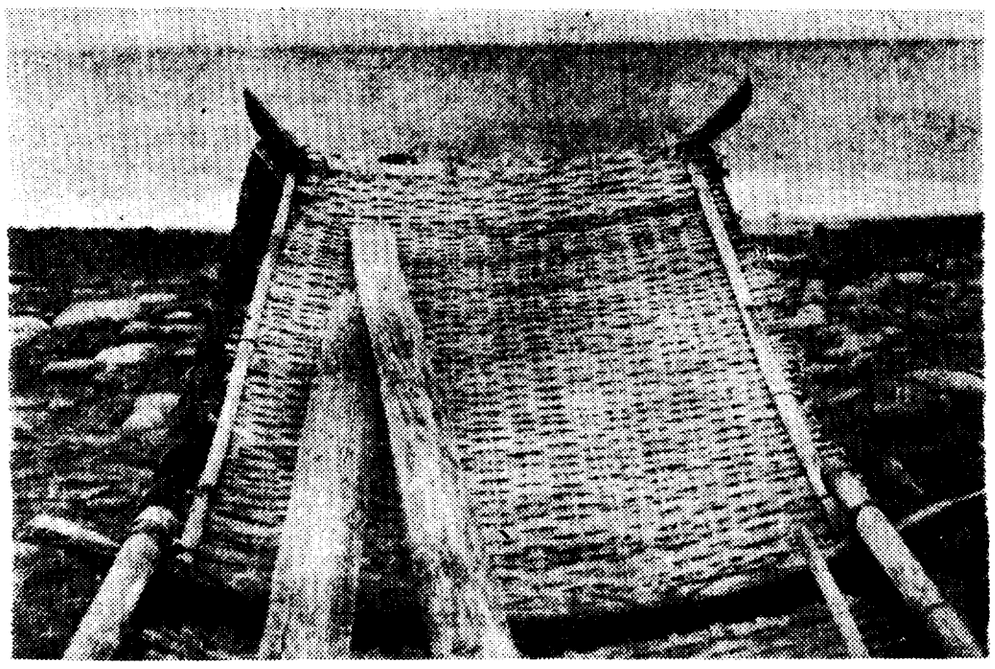

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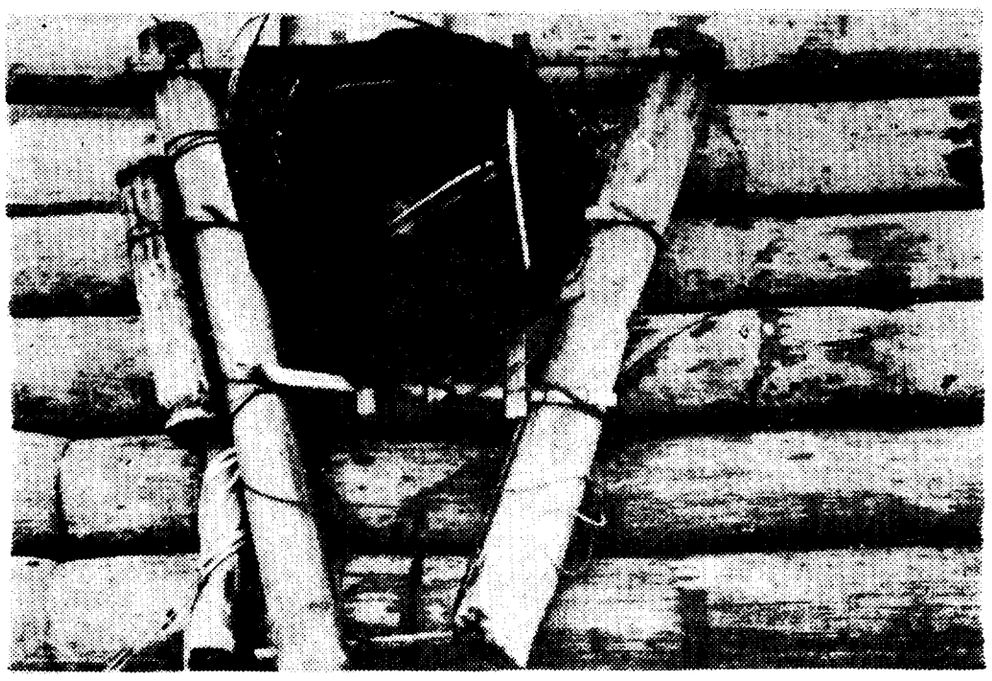

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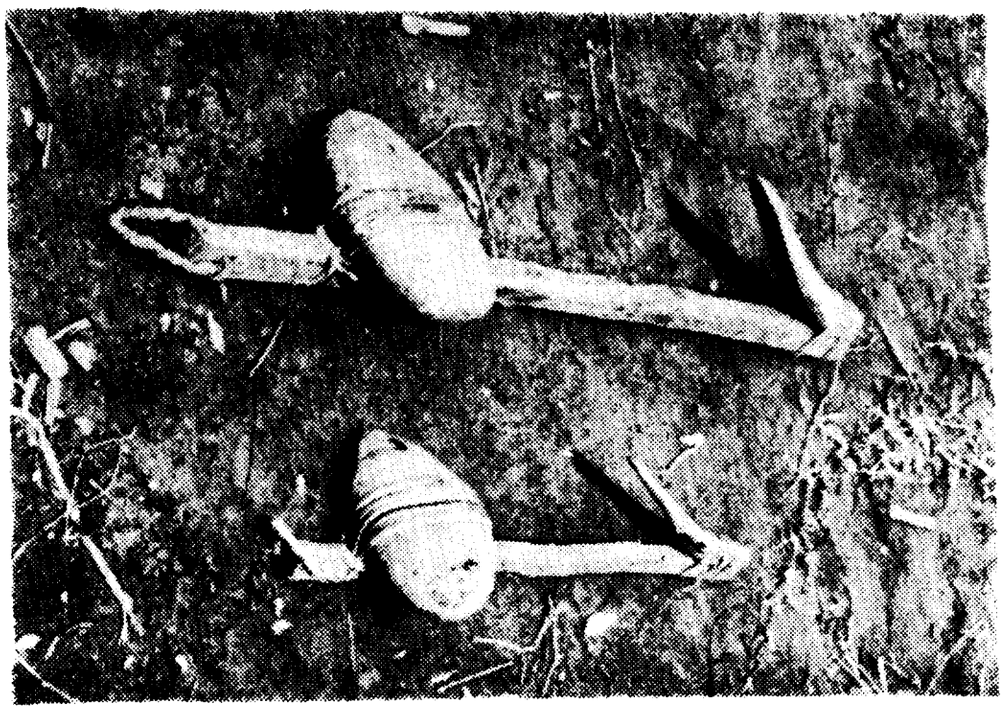
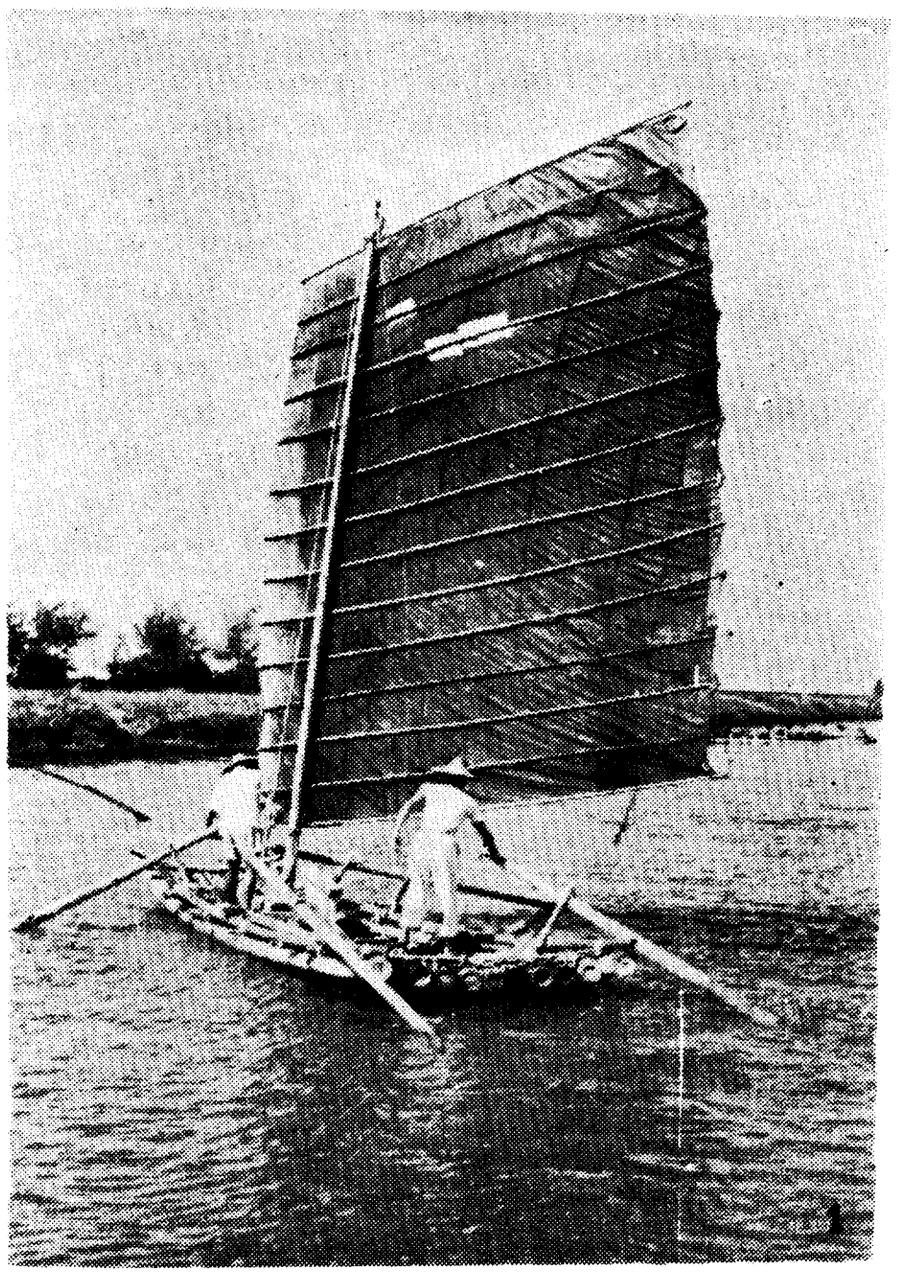


6

1. 沉網石及石錨　2. 水盆　3. 墊網蓆　4. 海燈　5. 繫槳繩圈　6. 石錨

1. Net sinkers and anchors made of stone.
2. Wooden pail for drinking water.
3. Mat-pad for fishing nets.
4. Oil lamp in gauze wrapping. The lamp floats by means of the bamboo to which it is attached.
5. Loops for the rudders.
6. Stone anchors.



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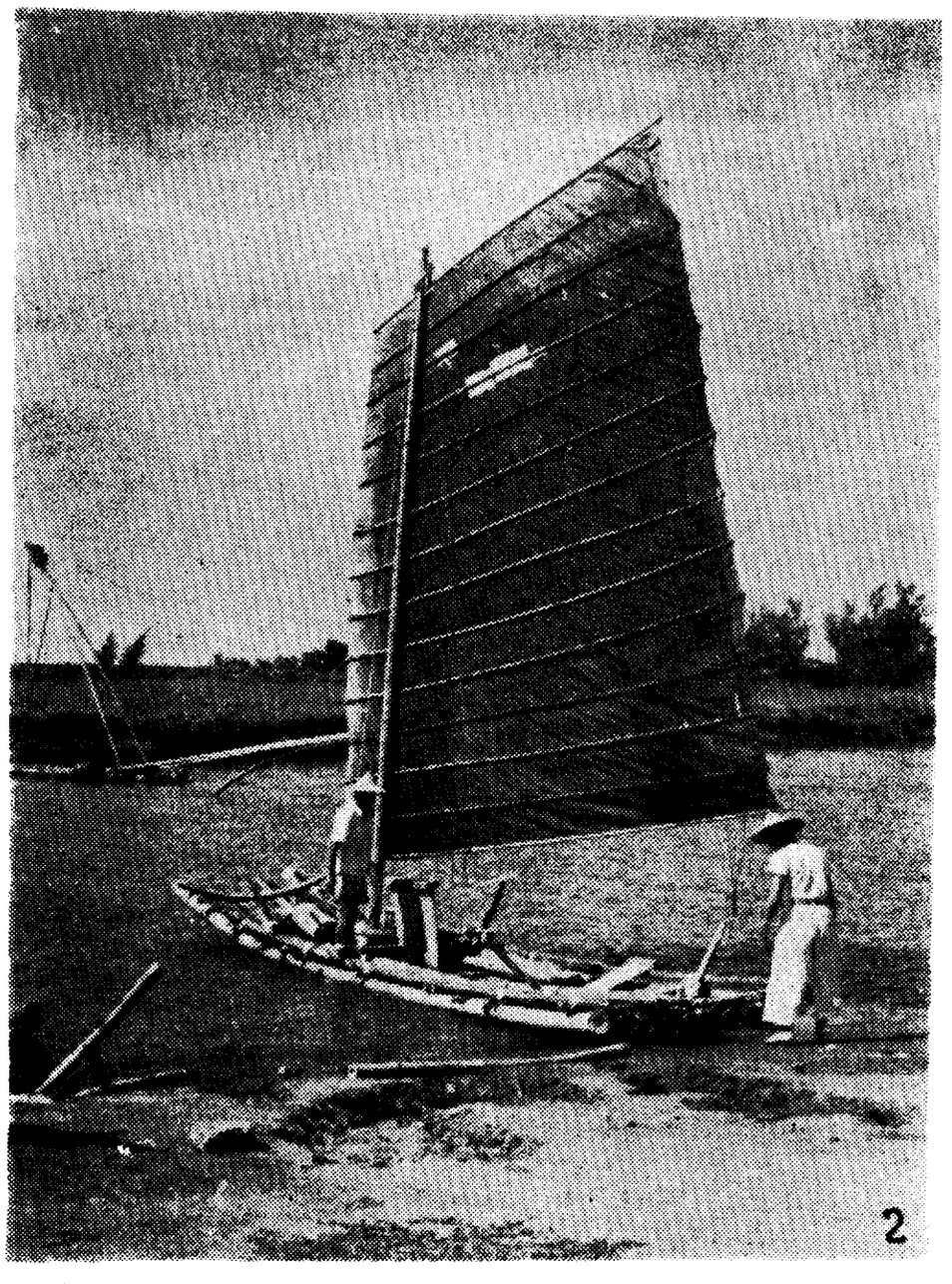

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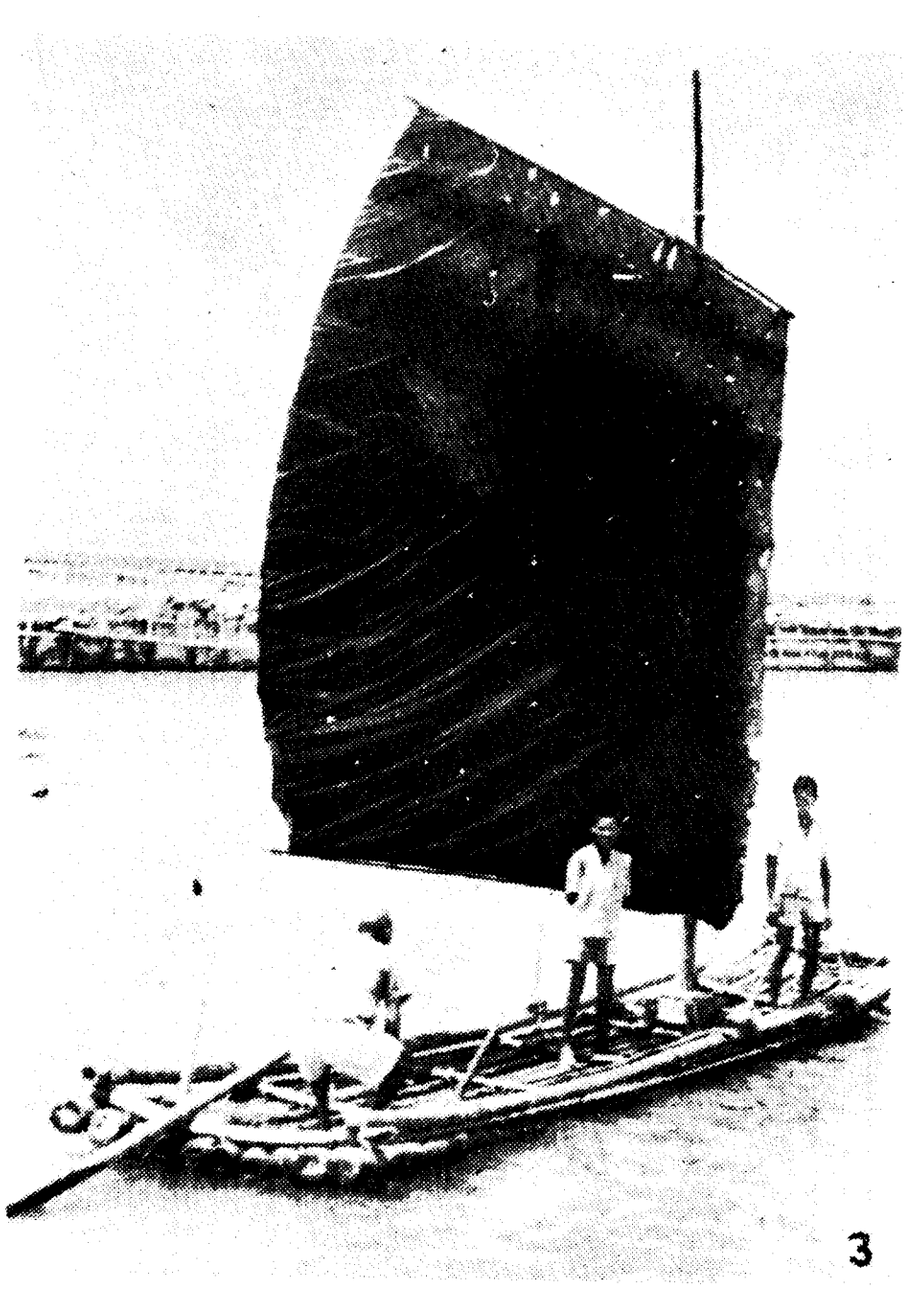

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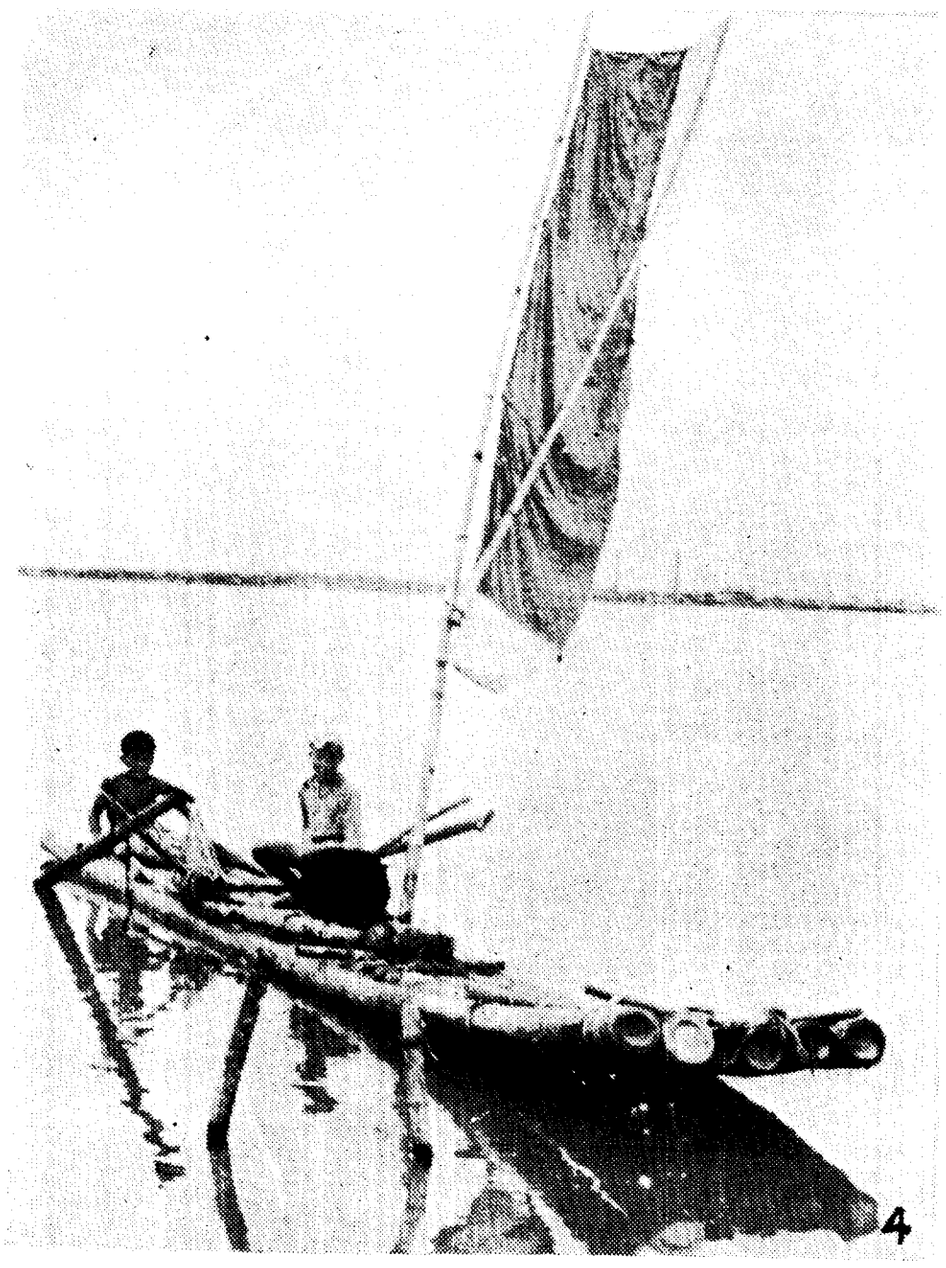
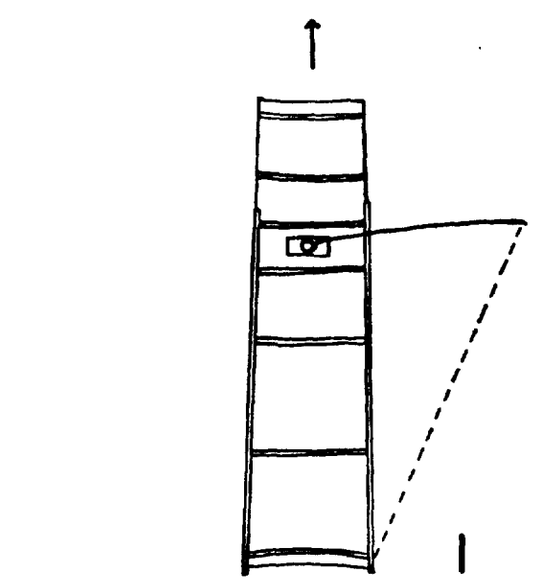
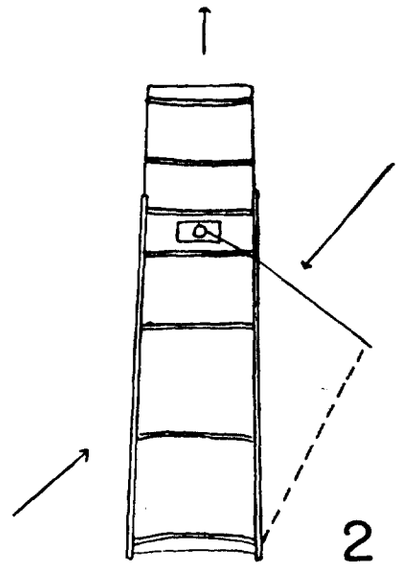


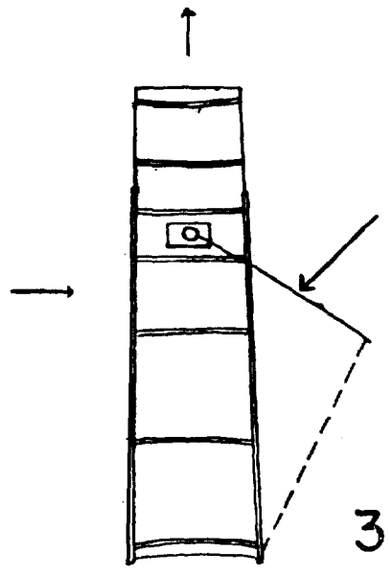
4

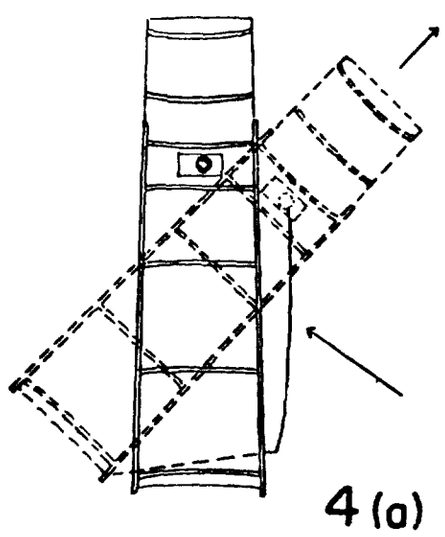
1. 左右槳舵　2. 帆及緯桿　3. 中央槳舵　4. 紅毛港小帆筏

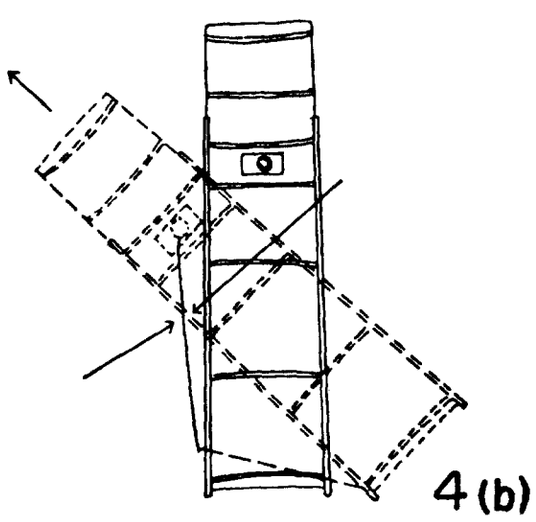
1. Position of rudders.
2. Sail with horizontal bamboo poles.
3. Rudder in central position.
4. The Hung Mao Kang raft.

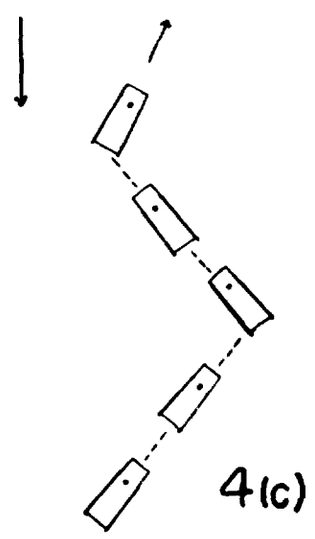


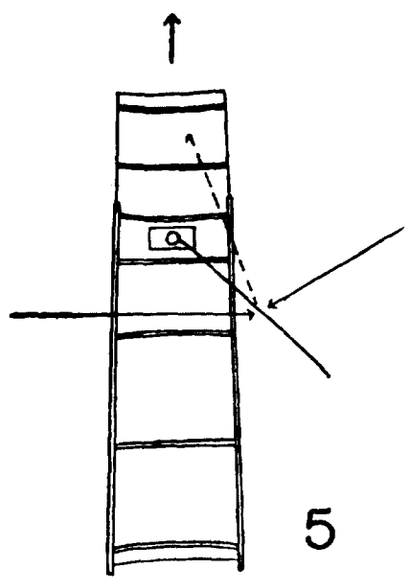


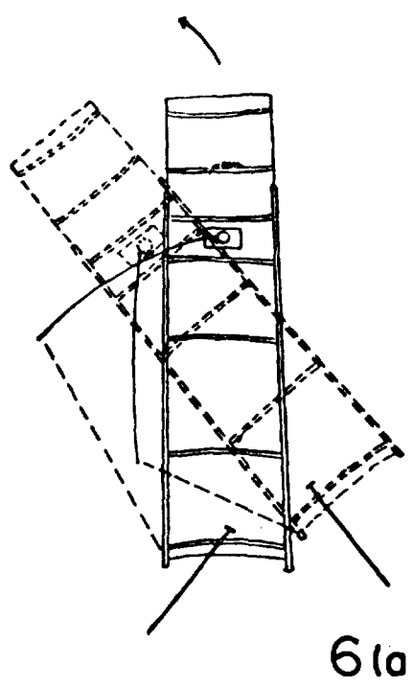


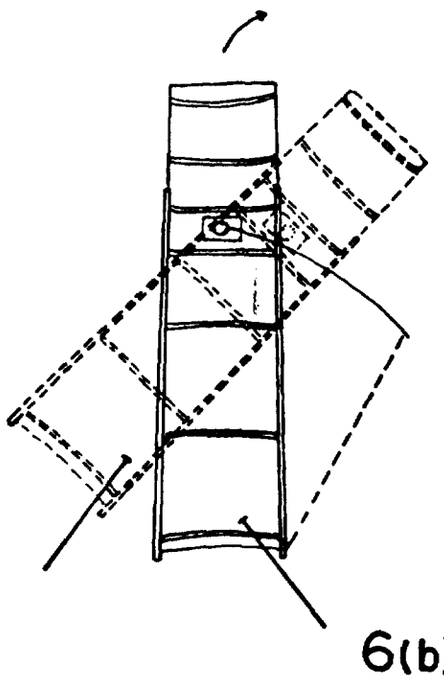


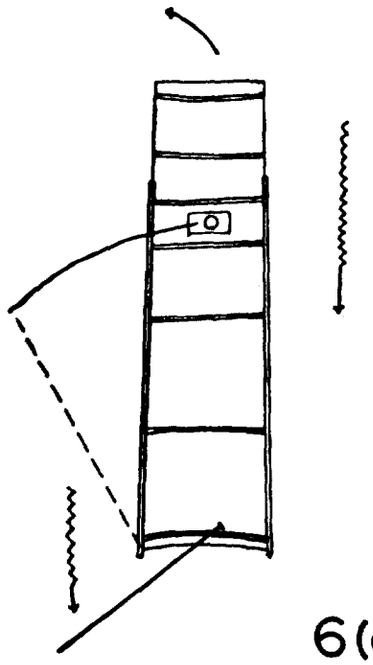


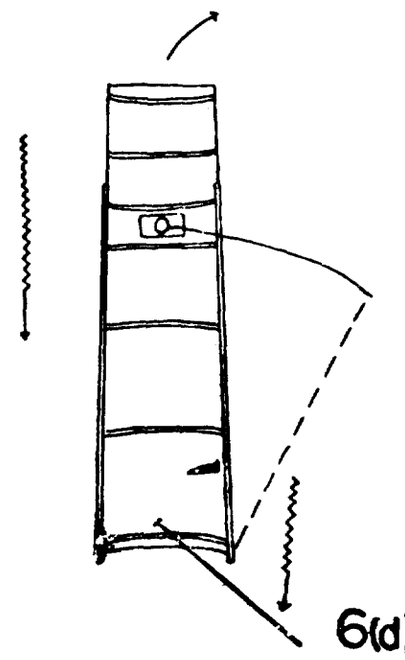








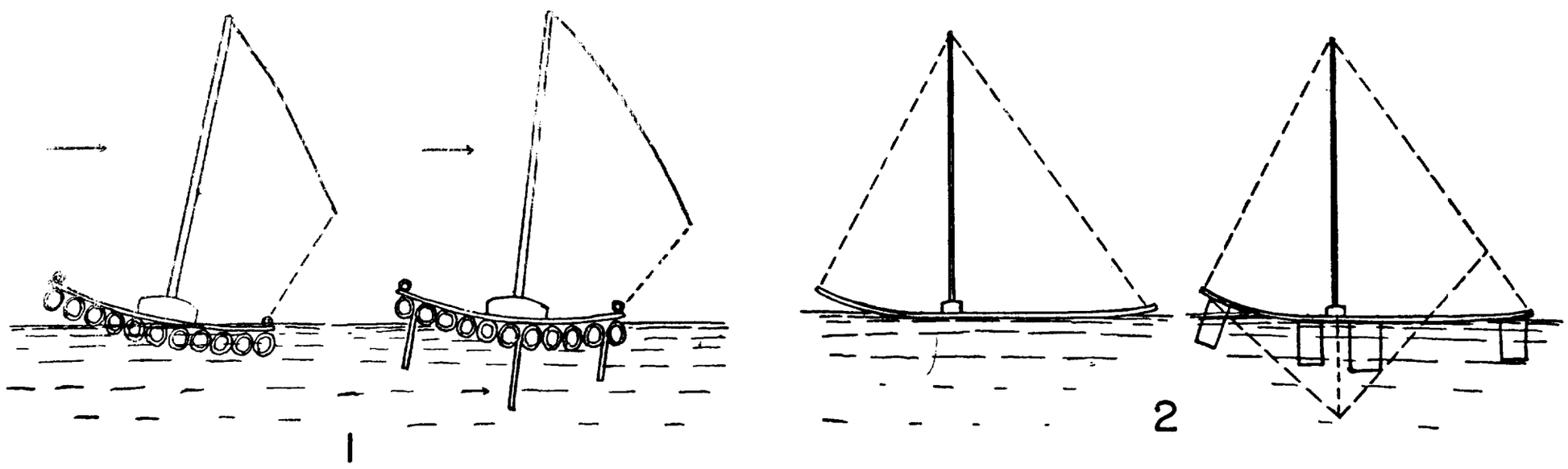




1. 順風之筏位　　2. 左右後側45°風向時之筏位　　3. 左右側90°風向時之筏位
4. (a)(b)逆風時之筏位及航向，(c)逆風時航行之路線
5. 風力及帆之反作用力構成之合力卽航向
6. (a)左轉，(b)右轉，(c)左轉時水作用於左槳舵，(d)右轉時水作用於右槳舵

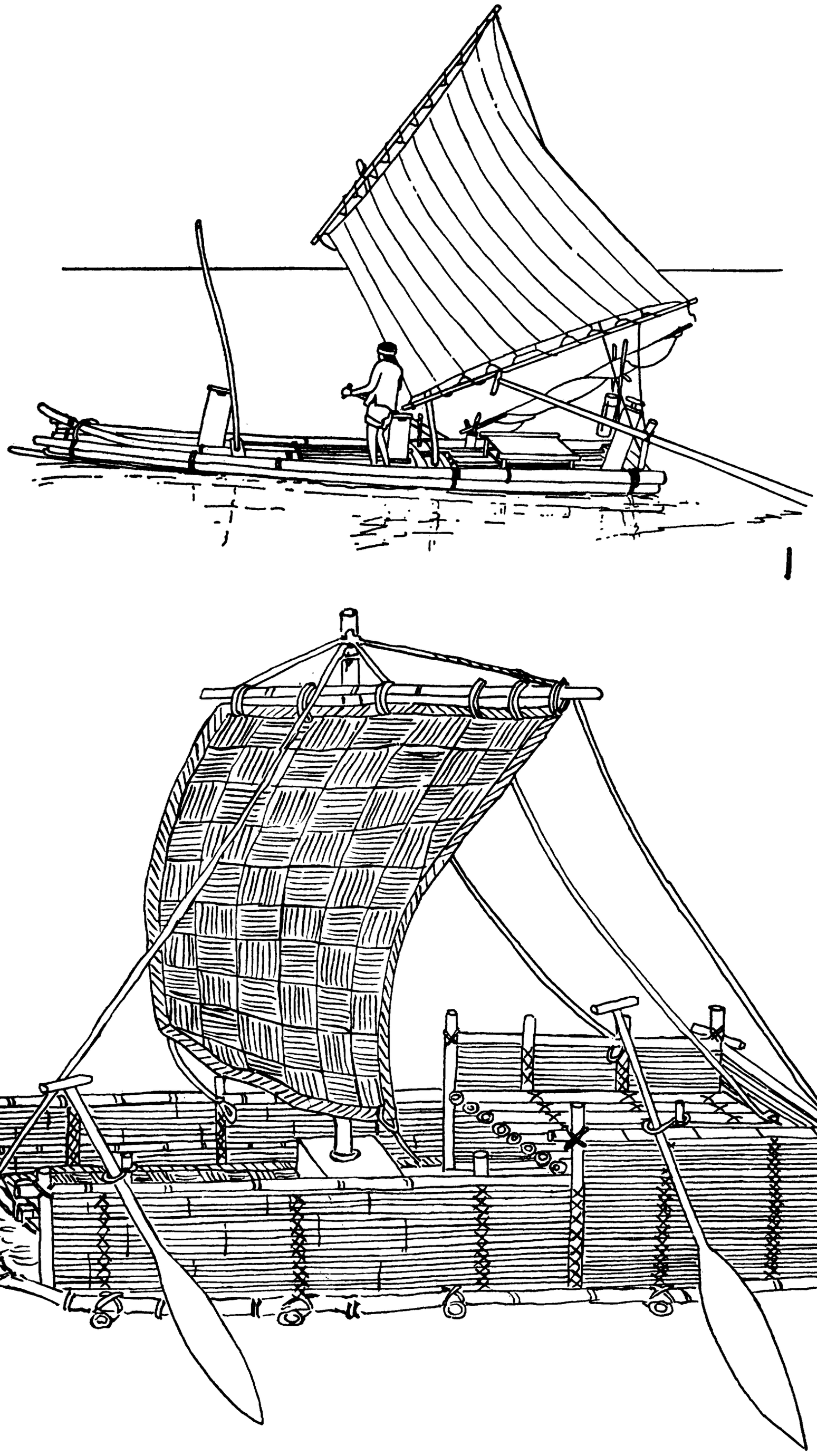
1-5. Course of the raft seen from above. Arrows indicate the direction of the wind, according to which the sail is adjusted.

6. Adjustement of the rudder according to position of the sail.



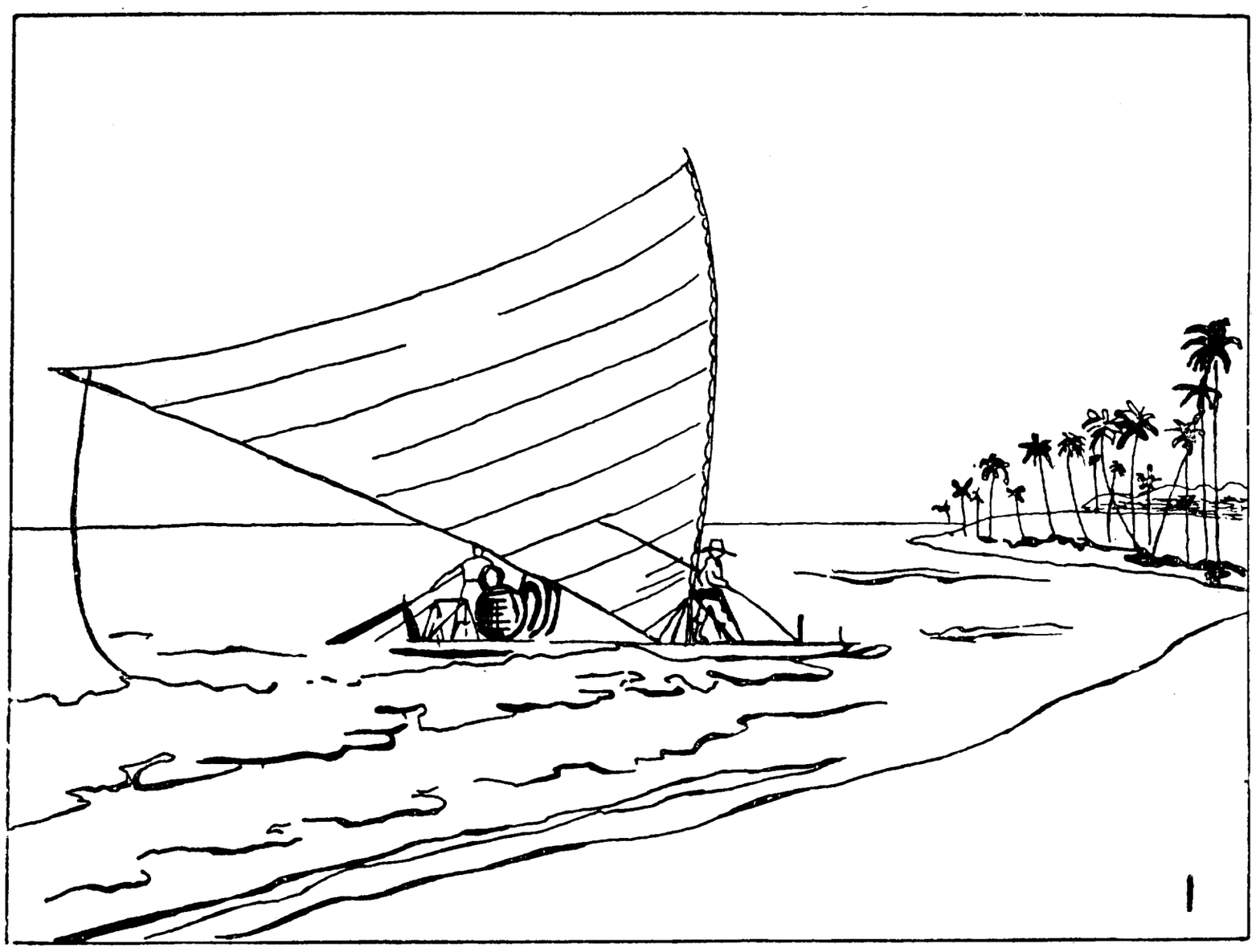
1. 加插板後減少筏身傾斜度
2. 加插板後重心降低平衡筏身
3. 加插板後減少筏身漂擺
4. 加插板後減少海流漂移航向
5. 後插板水中反作用力減少筏身傾斜
6. 前插板插於筏身傾斜入水之一側

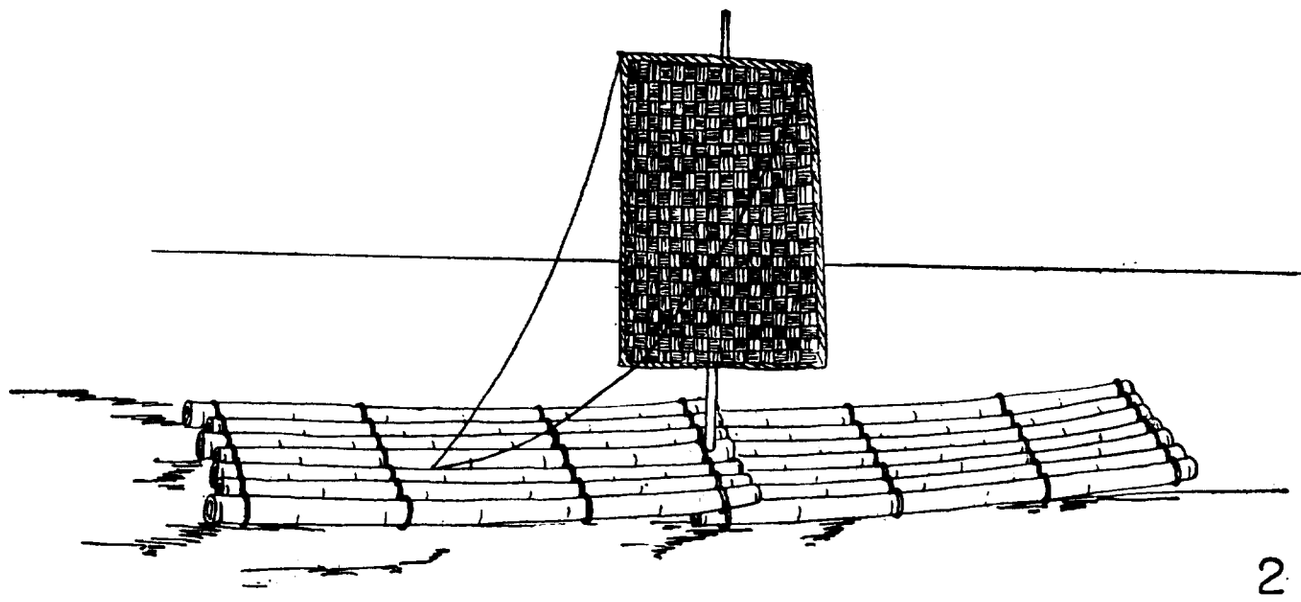
1. By lowering the center-boards the raft keeps its balance.
2. Shifting of the center of gravity by the use of the center-board.
3-4. Center-boards counteract the undulating movement of the water.
5-6. Boards lowered at stern or bow counteract the pressure of the wind upon the sail.

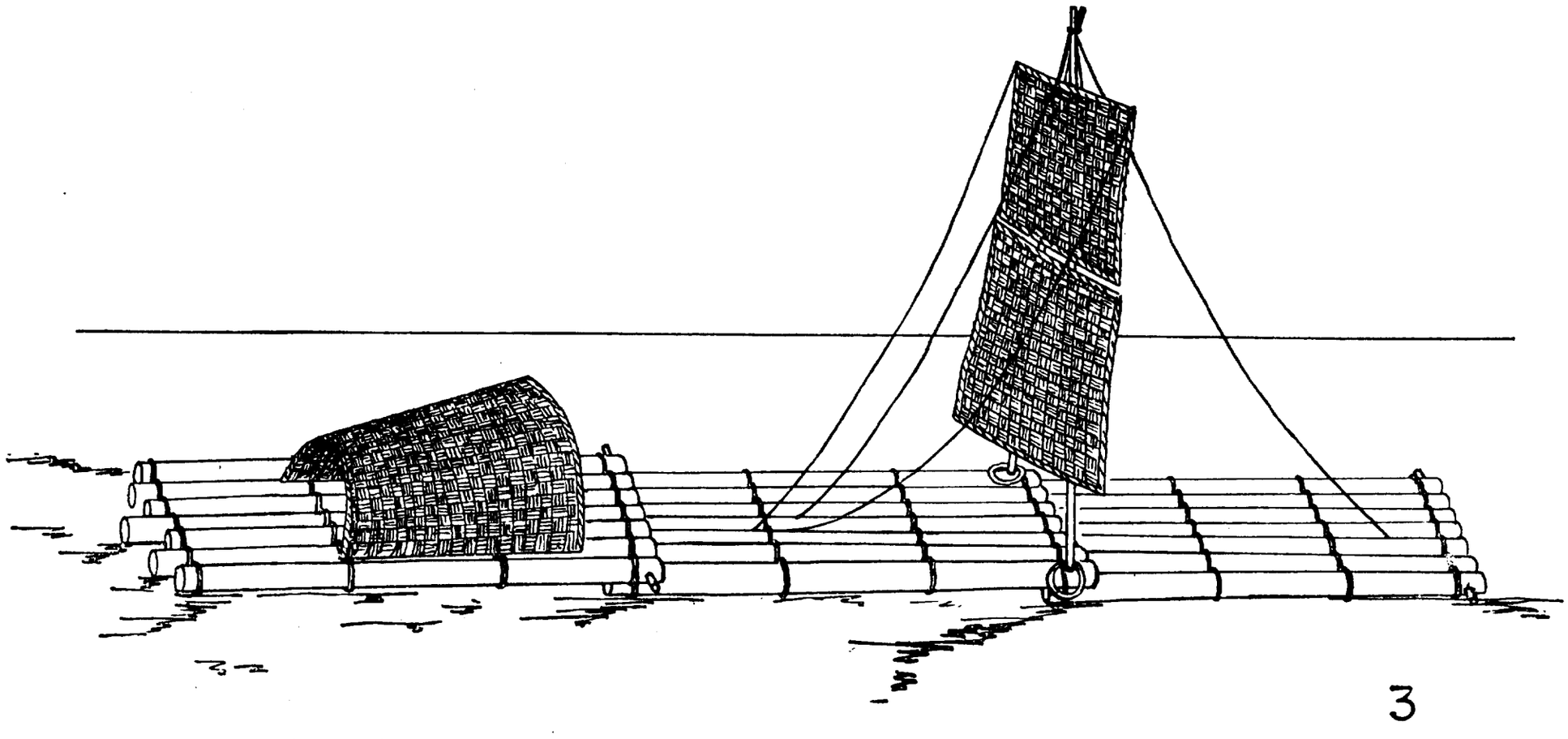


1. Claeys 氏繪 安南 Thanh-hoa 省木筏　　2. 1803年日人秦貞廉所記臺東秀姑巒帆筏

1. Wooden raft from North Annam. (From Claeys, 1942.)
2. Japanese sketch of raft from Tai-tung, Formosa. 1803.

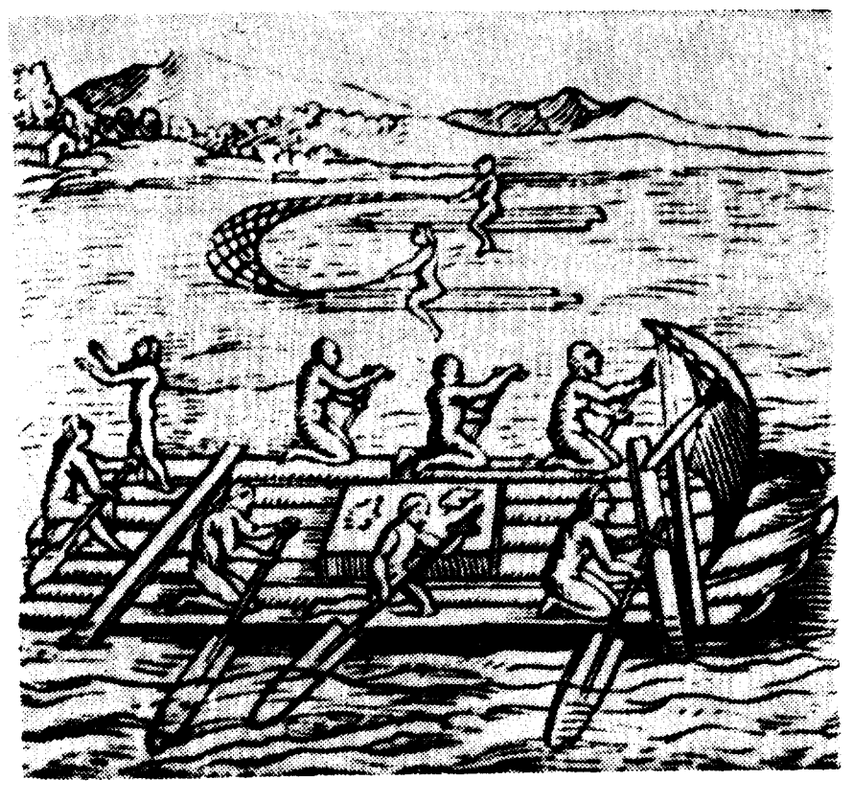




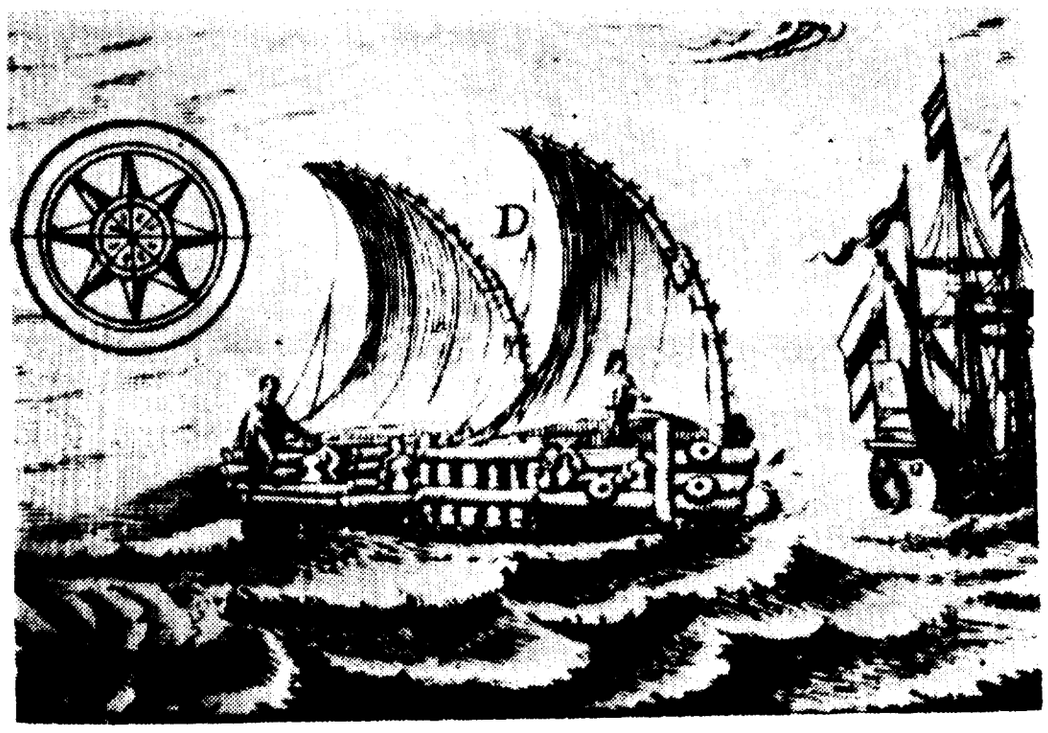


1. 南美東部巴西三角帆筏　　2. 大陸江南單桅竹筏　　3. 大陸江南剪桅木筏

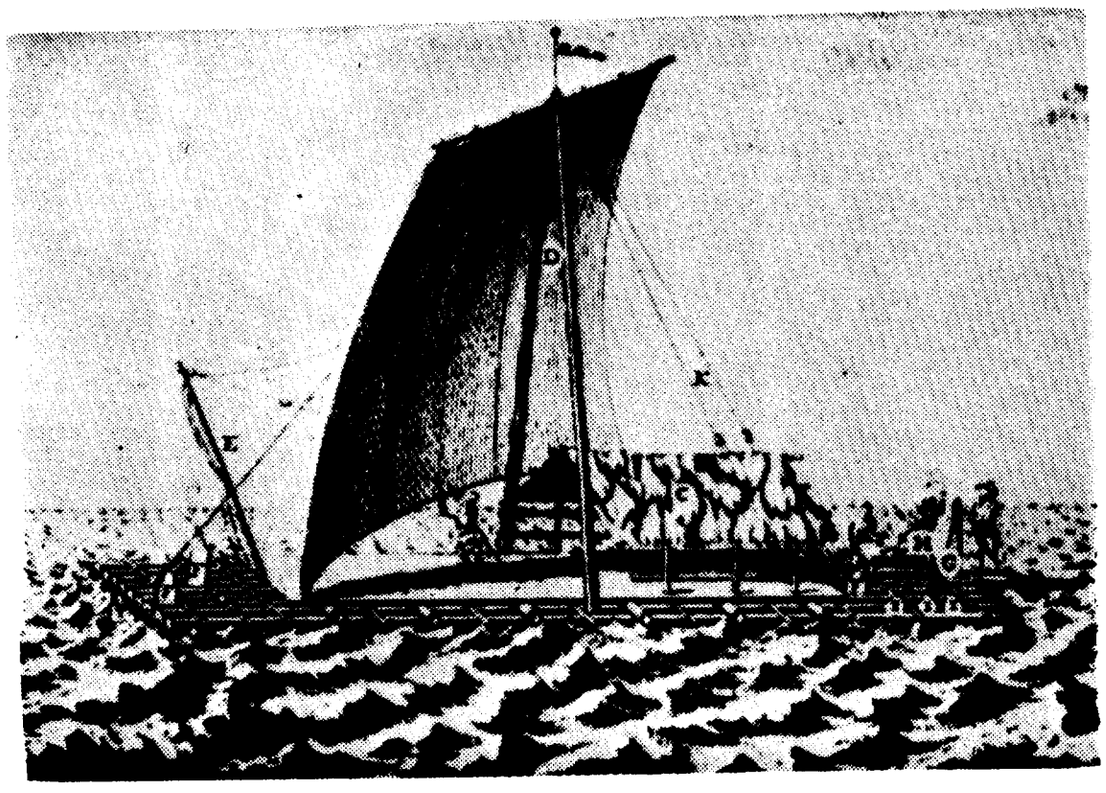
1. Triangular sail with raft from Brazil. (From Heyerdahl, 1952.)
2. Raft on the lower Yangtse river with simple mast.
3. The same with sheer mast.



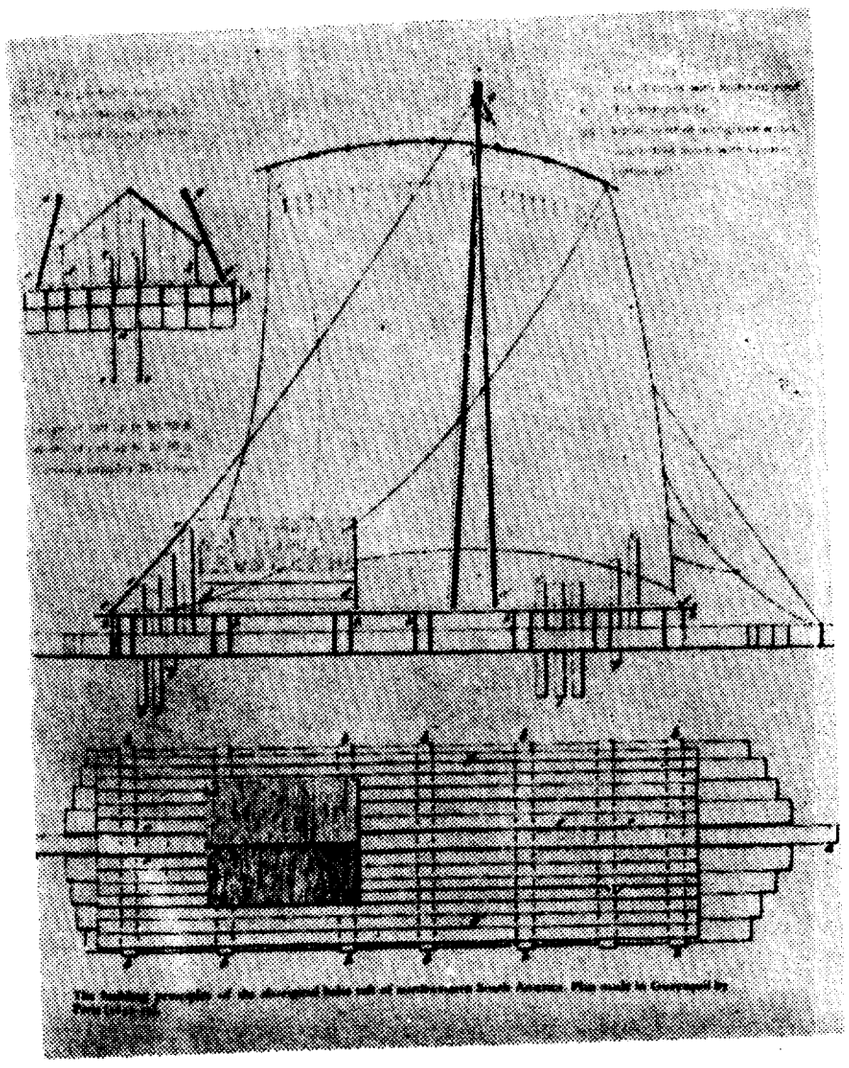
1. 意大利人 Benzoni 所繪南美筏圖
Peruvian balsa rafts. (From Benzoni, 1565.)



2. Spilbergen 氏在秘魯 Payta 港遇到的帆筏
Drawing of a Peruvian raft. (From Spilbergen, 1619)



3. 西班牙軍官 Juan 和 de Ulloa 對 balsa 的構造所繪的圖
Drawing of a raft Guayaquil, (From Juan and Ulloa, 1718)



4. Paris 氏在 Guayaguil 港實地調查所繪筏圖
Plan for construction of the raft of Guayaqui.(From Paris, 1841)

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