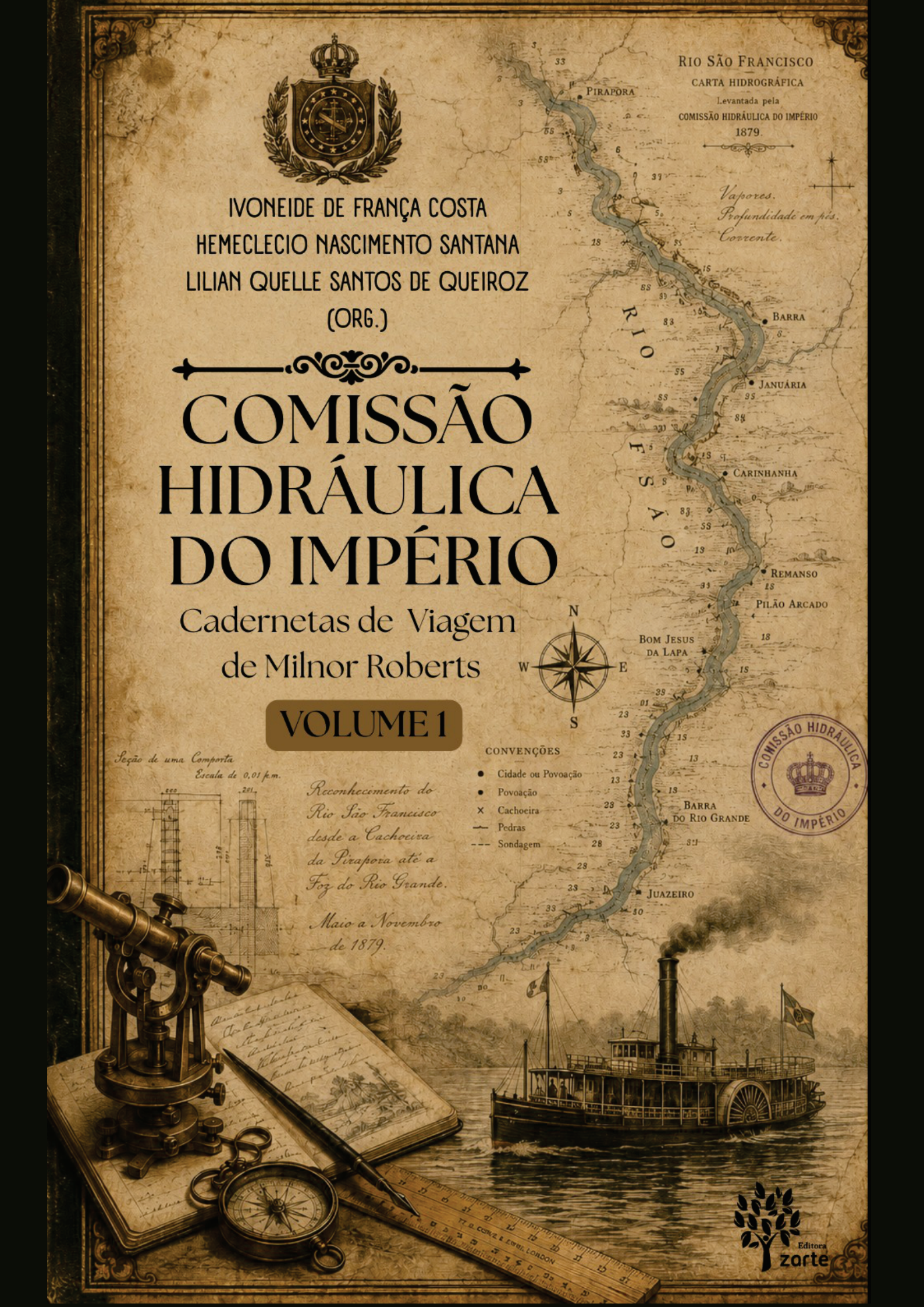
IVONEIDE DE FRANÇA COSTA
HEMECLECIO NASCIMENTO SANTANA
LILIAN QUELLE SANTOS DE QUEIROZ
(ORG.)

# COMISSÃO HIDRÁULICA DO IMPÉRIO

## Cadernetas de Viagem de Milnor Roberts

**VOLUME 1**




Editora zarte

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IVONEIDE DE FRANÇA COSTA
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Orgaizadores

# COMISSÃO HIDRÁULICA DO IMPÉRIO: CADERNETAS DE VIAGEM DE MILNOR ROBERTS (1979)

VOLUME 1

Editora zarte
Feira de Santana - Bahia
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# APRESENTAÇÃO

No final século XIX, o Conselheiro Cançanção de Sinumbú organizou a Comissão Hidráulica do Império, sob a direção do engenheiro americano William Milnor Roberts, e com a participação dos engenheiros Antonio Plácido Peixoto do Amarante, Rodolpho Waisser, Domingos Sergio de Sabóia e Silva, Alfredo Lisboa, Miguel Antonio Lopes Pecegueiro, Theodoro Fernandes Sampaio, Thomaz de Aquino e Castro e o geólogo Orville A. Derby na qualidade de adido da expedição. A comissão tinha o objetivo de estudar os melhoramentos do porto de Santos e a navegação pelo interior do País, também se propunha em preparar profissionais brasileiros para posteriormente participar de atividades de melhoramentos dos problemas identificados pela expedição e obras de crescimento nacional.

Após a finalização dos estudos do porto de Santos, a Comissão iniciou os estudos da navegação pelo interior do País pela exploração do rio São Francisco devido a sua posição geográfica em relação à zona litoral povoada e enriquecida, e pelo seu vale servir de comunicação entre as regiões centrais e norte do País (SAMPAIO, 1998). Após preparativos, iniciou-se em 12 de Agosto de 1879 a viagem que iria percorrer desde a ligação do rio São Francisco com o Atlântico em Alagoas indo até Pirapora em Minas Gerais. Este trajeto foi concluído em 17 de Dezembro do mesmo ano. O interesse pelo Conhecimento do Rio São Francisco residia na necessidade de realizar um sistema de viação pelo interior do País que ligasse os portos ao rio. As estradas de ferro já estavam sendo construídas partindo do Rio de Janeiro, Bahia, Pernambuco e havia necessidade de traçar um percurso através do rio.

A Comissão Hidráulica do Império (CHI) foi organizada através do Aviso nº. 5 de 14 de fevereiro de 1879, por iniciativa do Conselheiro João Lins Vieira Cansanção de Sinimbu, então Ministro dos Negócios da Agricultura, Comércio e Obras Públicas. O objetivo da CHI era estudar os possíveis melhoramentos a serem realizados no porto de Santos e as condições de navegabilidade do rio São Francisco. Visava também preparar profissionais brasileiros para, posteriormente, participarem das atividades de melhoramentos dos problemas identificados pela expedição e obras de crescimento nacional. Para Ademir Pereira dos Santos, a CHI se inseria no "contexto histórico do planejamento territorial, origem distante do urbanismo moderno no Brasil, cuja motivação também se relaciona à adoção de sistema de

transporte a vapor, característica da primeira Revolução Industrial", cujo processo assinalaria investimentos tecnológicos expandindo os mercados. Este contexto aliava o planejamento territorial ao planejamento urbano na busca de melhoramentos da infraestrutura de vida social e do sistema de viação, unindo rios, estradas e portos, a fim de permitir o escoamento da economia do país do centro para o litoral, e do litoral para outros Estados, províncias e/ou países. O mesmo processo também acontecia de forma inversa: na entrada de pessoas e produtos do litoral para o centro. Os aprimoramentos das vias de comunicação configuraram-se como as mais importantes obras da engenharia no século XIX. Suas questões permitiram a profusão das discussões científicas e técnicas para adequar os sistemas de transportes ao crescimento das cidades e o aumento das importações e exportações, principalmente nos portos do Rio de Janeiro e Santos.

A CHI iniciou as atividades primeiramente pelos estudos no porto de Santos, SP, em resposta ao Aviso de 2 de abril de 1879. O porto já havia sido objeto de estudo de outros empresários e engenheiros, mas pouco fora realizado para melhorar o comércio e suas condições sanitárias. Coube à CHI realizar novos estudos, identificar os problemas e propor novos planos para que pudessem ocorrer os melhoramentos adequados ao porto. Ao término dos estudos no porto de Santos, atendendo ao Aviso de 29 de junho de 1879, a CHI iniciou a expedição através do rio São Francisco, da foz, no oceano Atlântico, até a cidade de Pirapora, em Minas Gerais. O objetivo dessa etapa dos trabalhos da Comissão era identificar os obstáculos que impediam a franca navegação pelo rio e propor soluções para os problemas identificados. Os estudos do rio São Francisco começaram no dia 12 de agosto de 1879, e se estenderam até 22 de dezembro do mesmo ano. Esta parte dos trabalhos teve a presença do geólogo Orville Adalbert Derby, designado pelo Governo para realizar estudos geológicos do vale.

Para chefiar a CHI, foi contratado o engenheiro militar americano William Milnor Roberts pelo período de três anos, nos quais se dedicaria ao estudo do sistema fluvial do Brasil e, ao final, deveria indicar meios "práticos e econômicos" de integrar os rios ao sistema de comunicação entre o centro do país e a costa marítima. A contração foi celebrada não só pela experiência do engenheiro, mas, também, pela possibilidade de estreitar as relações com os Estados Unidos. W. M. Roberts já havia estado no Brasil entre 1857 e 1865, trabalhando na Estrada de Ferro D. Pedro II, acompanhado por outros engenheiros americanos contratados pelo Eng. Christiano B. Ottoni para executar as obras da Segunda Seção da Ferrovia da Estrada de Ferro D. Pedro II.

A composição da CHI ficou definida pelos seguintes engenheiros: William Milnor Roberts, engenheiro chefe; Antonio Plácido Peixoto do Amarante, 1º. engenheiro; Rudolph Wieser, chefe da seção; Domingos Sérgio de Sabóia e Silva, Al-

fredo Lisboa, engenheiros 1ª. classe; Miguel Antonio Lopes Pecegueiro, Theodoro Fernandes Sampaio, Thomaz de Aquino e Castro, engenheiros de 2ª. Classe; João P. Rocha Pita, auxiliar (integrante que só aparece na lista escrita por W. M. Roberts); e o geólogo Orville A. Derby, na qualidade de adido da expedição através do rio São Francisco.

William Milnor Roberts dedicou sua vida ao desenvolvimento da engenharia nos Estados Unidos e no Brasil. Roberts nasceu na Filadélfia, Pensilvânia, em 1810, filho de Thomas Paschall e Mary Louise Roberts. Casou-se duas vezes: o primeiro casamento foi em 1837, com Annie Gibson, da Pensilvânia, com quem teve seis filhos; depois se casou com Adeline Debeelen, de Pitsburg, com a qual teve quatro filhos. Sua educação foi na Filadélfia em escolas particulares. Também fez curso de desenho arquitetônico na primeira escola estabelecida pelo Franklin Institute, com o arquiteto John Haviland. Depois de começar exercer a profissão de engenharia civil, continuou os estudos, principalmente em matemática, da qual gostava muito. Começou sua vida profissional em 1825, trabalhando no Canal da União da Pensilvânia e, em 1830, na construção de ferrovias. Sua carreira como engenheiro teve início e crescimento com o maior dos agentes em nossa civilização moderna, a engenharia ferroviária. Nos Estados Unidos, as construções ferroviárias começaram em 1826, na pedreira de granito chamada Quincy, onde construíram um bonde para o transporte de pedra da pedreira para a água, a uma distância de três ou quatro quilômetros. A primeira estrada de ferro, no entanto, foi a Mauch Chunk, com nove quilômetros de extensão, entre o cume da montanha Broad Top e o plano inclinado Mauch Chunk.

No decorrer de sua longa carreira como engenheiro, Roberts ocupou variados cargos de confiança e responsabilidade. Em 1830, foi nomeado engenheiro residente da estrada de ferro Union e um canal Union. De 1831 a 1834, trabalhou como engenheiro-assistente sênior principal na ferrovia Allegheny Portage, período durante o qual tinha o encargo de reparos na divisão oeste do Estado da Pensilvânia do canal de Johnstown para Pitsburg, danificada pela enchente de 1832. De 1835 a 1857 foi contratado como engenheiro para vários projetos em Ohio, Indiana, Pensilvânia e Canadá, trabalhando como engenheiro chefe ou prestando consultorias. De 1837 a 1841 ocupou o cargo de engenheiro chefe nas melhorias dos rios em Monongahela, trabalhou nas obras do canal na Pensilvânia, o canal Erie, e as melhorias do rio Ohio. De 1841 a 1842 trabalhou na construção do canal de Welland (Canadá). De 1843 a 1844, exerceu a função de engenheiro chefe para a Companhia do Canal Erie, e de 1845 a 1847 foi engenheiro chefe na empresa Sandy e Beaver, de Ohio. Em 1849 recusou o convite para ser chefe da primeira ferrovia na América do Sul para aceitar trabalhar na ferrovia Bellefontaine e Indiana, de Ohio, onde permaneceu até 1851. Entre 1852 e 1854 foi engenheiro

chefe da ferrovia Allegheny Valley. De 1855 a 1857 foi contratado para ferrovia em Minnesota, além de prestar consultoria em Pitsburg e outras cidades.

'No período compreendido entre 1857 e 1865 foi responsável pela construção do caminho de ferro D. Pedro no Brasil, como já foi mencionado, permanecendo no trabalho até a conclusão da obra, em 1864. Durante o restante de 1864 e parte de 1865 visitou várias ferrovias e obras públicas no Brasil e nas repúblicas platinas, retornando para os Estados Unidos ao final de 1865. Após seu regresso foi contratado para importantes obras hidráulicas e ferroviárias, tais como a melhoria dos rios Ohio e Mississipi, a construção da ponte de St. Louis Bridges, abastecimento de água de Pittsburgh e Filadélfia, e construção de uma ferrovia em Nova Scotia.

Em 1869, Roberts fez o reconhecimento de uma rota para a estrada de ferro do Pacífico Norte, que incluiu a rota através de Montana. Seu relatório, publicado por Jay Cooke, serviu de base para o financiamento da construção da linha para a costa do Pacífico. Atuou como engenheiro chefe da Northern Pacific Railroad de 1870 a 1879. Em 1874 partiu numa expedição com mais cinco engenheiros para examinar as embocaduras dos grandes rios do delta da Europa, a fim de recomendar o tratamento do delta do Mississipi.

No final de 1878, Roberts aceitou a nomeação do Governo Brasileiro para um exame do porto e águas do Império, com referência à sua melhoria – a Comissão Hidráulica do Império. Seu contrato era para um período de três anos, começando em 1879. Ele saiu de Nova York no dia 04 de janeiro de 1879 e chegou ao Rio de Janeiro no dia 27 do mesmo mês. Ao chegar, foi imediatamente fazer o exame do porto de Santos e entrou em seu novo trabalho no mês de fevereiro seguinte. Esta tarefa foi concluída em junho, e no dia 31 de agosto W. Roberts partiu para uma análise ampliada do Alto São Francisco.

Além dos trabalhos da CHI, Roberts também fez estudos e outros trabalhos de grandes escalas no país. Realizou estudos na Barra do Rio Grande, no Rio Grande do Sul, em 1881, (faleceu antes de inicar os trabalhos); apresentou projeto para o porto do Recife PE, após estudos dos engenheiros John Hawskhaw e Raphael Galvão; o porto de São Luiz, no Maranhão, também foi contemplado com um projeto de W.M. Roberts, em 1881. Fez parte de uma comissão para estudo do reservatório do Pedregulho no Rio de Janeiro com outros engenheiros ilustres da época, como André Rebouças, Honório Bicalho e Raymundo Belford Roxo. Também foi encarregado pelo Governo Imperial de realizar estudos e projetos de abastecimento de água em várias cidades.

Roberts participou de importantes associações. Foi membro da American Society of Engineers, da Institution of Civil Engineers e da American Geographical Society. No Brasil foi sócio honorário do Clube de Engenharia do Rio de Janeiro, admitido no ano de 1881. W. M. Roberts morreu de febre tifóide em Soledade,

MG, Brasil, aos 72 anos, quando trabalhava na estrada de ferro, em 14 de julho de 1881, e sepultado no dia seguinte no cemitério da freguesia de Carandaí, cidade próxima a Barbacena - MG. Em 1923, o edifício de engenharia no Estado Montana Campus foi nomeado em sua homenagem.

As cadernetas que se seguem se referem as atividades da CHI e fazem parte do acervo da Universidade de Montana, USA.

Professora Dr. Ivoneide de França Costa
Universidade Estadual de Feira de Santana

Professora Dr. Lilian Quelle dos Santos Queiroz
Universidade Estadual de Feira de Santana

Professor Ms. Hemeclecio Nascimento Santana
Universidade Estadual de Feira de Santana

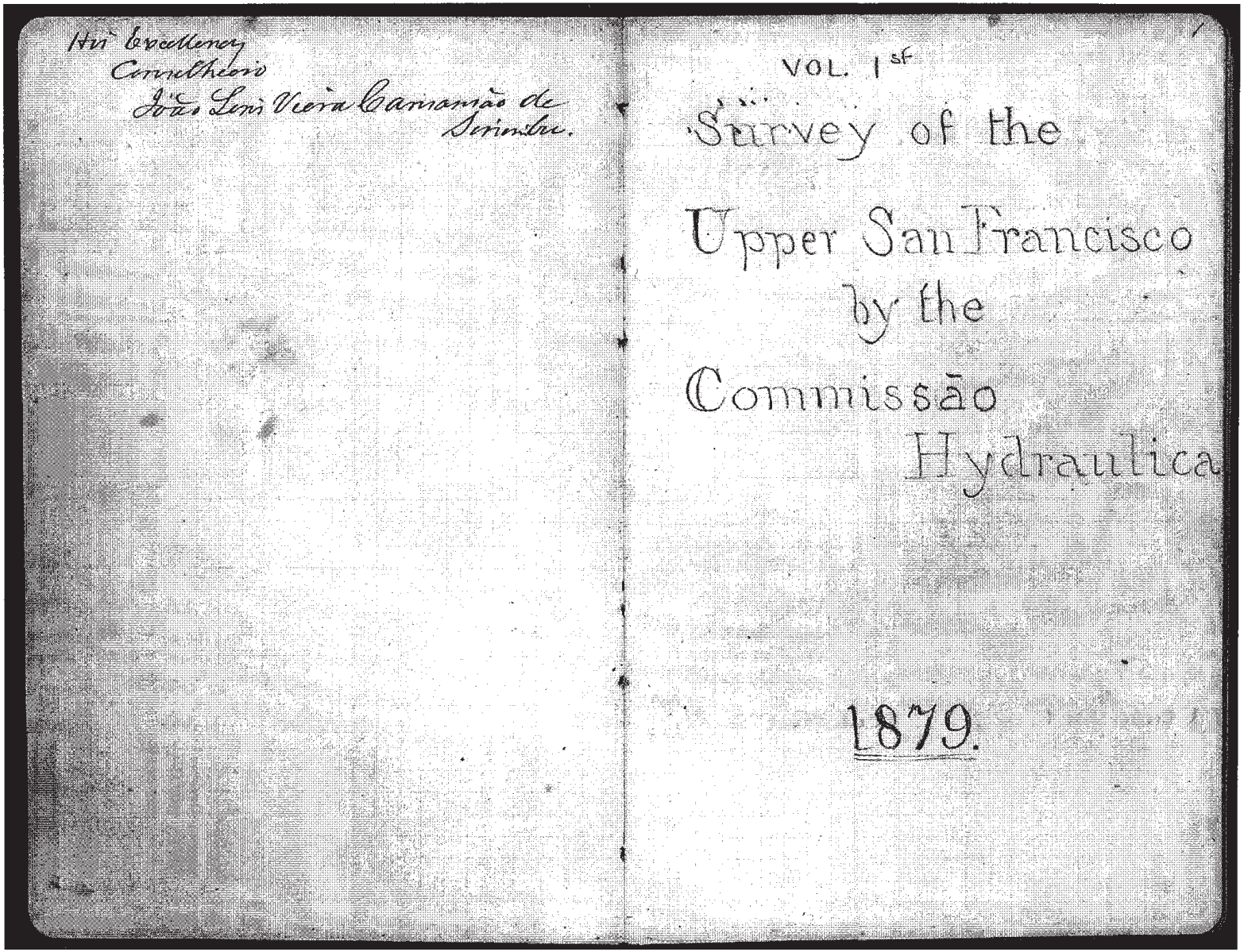
Collection 783

William Milnor Roberts Papers

Box 4

Folder 28

Part 1


Hiz Excellency
Conselheiro
João Luiz Vieira Cansansão de
Sorimbre.
VOL. 1 sf
Survey of the
Upper San Francisco
by the
Commissão
Hydraulica
1879.

## Dimensions of Steamer "Presidente Dantas"

| | | |
|---|---|---|
| Length | 98 | feet |
| Beam | 14 | " |
| of Wheel Houses | 26 | " |
| 2 cylinders | 12 | inches |
| Stroke | 24 | " |
| Diameter of Wheel | 10' 9" | " |
| Width " " | 4' 10" | " |
| Number of buckets | 10. | |
| Depth " " | 10 | inches |
| Boiler length | 10' 8" | |
| Dia. | 5. 9" | |
| Tubes Size | 2 1/2 | |
| Number of tubes | 96 | |

Pounds of Steam av. 35 lbs.

40 lbs. gave 26 revolutions
35 " " 20 " } Mean initial steam
30. " 17 "

Draught of vessel loaded
Forward 3' 3"
Aft 3.

1 Cubic Metre = 35.287 Cubic Feet. Say C. Feet. 35.28



## 2d Measurement of the river flow at Pirapitas January 23d 1880. Sr. Ribeiro

| | |
|---|---|
| Total Area | 5331 Square metres |
| Volume per Second | 2196 Cubic metres |
| Mean Velocity | 0.41 per sec. = 0.92 M. per H. |
| Greatest Depth | 43 metres. |

The above is based on 0.9 of the Superficial Vel.s
Taking it at 0.8 it would give as follows:

| | |
|---|---|
| Volume per secd | 1952 Cubic metres |
| Mean Velocity | 0.36 per sec. = 0.81 M. per H. |

NOTE,
The river is about 1 metre higher than when the 1st measurement was made Augt 1879.

I calc the flow Jan. 23d 1880 2000 c.m. per Secd
or 120,000 Cubic metres per minute
= 4,233,600 Cubic Feet per minute.

Thursday August 21, 1879 Rio de Janeiro 5

Mr Gilchrist Secretary of Legation arrived this morning and brought me a telegram from Mr Osborn ordering me to Montevideo. Left Rio at 4 P.M. and for the Council Room at Petropolis, where we called on Mr Seward & had a talk with him. Returned to Rio at 8 P.M. and called at Pinheiro Machado's house. Found him at home and had a talk with him. Returned to Rio at 9 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 10 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 11 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 12 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 1 A.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 2 A.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 3 A.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 4 A.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 5 A.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 6 A.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 7 A.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 8 A.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 9 A.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 10 A.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 11 A.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 12 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 1 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 2 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 3 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 4 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 5 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 6 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 7 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 8 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 9 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 10 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 11 P.M. and called at Mr Seward's house. Found him at home and had a talk with him. Returned to Rio at 12 A

6) Thursday Aug 21 — Continued

"Chico" Peranhas.

Verissimo Secretary during the work, with the aid of the Carpenter and our Cooks. I also made out a list of additional provision to be had from Snr. Venturi.

| | | | |
|---|---|---|---|
| 10 sacks | Farinha | | 4 Rolls of onions |
| 6 " | Beans | Feijão | |
| 2 " | Salt | Sal | Snr. Venturi's |
| 4 " | Rice | Arroz | Estimate of the |
| 100 Kilos | Sugar | Assucar | Consumption for |
| 50 Kilos | Coffee | Café | man, war-Pay. |
| | | | 1 Saco of Farinha |
| | | | ½ " " Feijão |
| | | | 1 lb. of Carne sacca |

Mr Venturi said we would require 6 men to each double Canoe — I pay, had 4 double canoes, 24 men. I will try to get along with 3 double canoes — and 18 men in place of 24.

My arrangement is, to go to Rodonda with the Bath-Team, instead of stopping at Jatobá. Mr Venturi indicated to Mr Weisen, upon the inquiry being made, that the Change to Jatobá would be 6 Milreis per animal, and to Rodonda about 9 Milreis per animal.

2d day, Chief Engr. Kruger has dispatched a Man to Jatobá — Rodonda and Cotia to engage Canoes, who the day following reach Caroba in 5 days and return and report to us.

After writing the Telegram, I wrote a letter to Comdr Flinio, sending copy of Telegram and referring to Mr Krueger this Essay of Mr Venturi — and also to Mr Darby, in Praia.

Thursday — Aug 21. Continued. Piranhas

and hoping we would be on the upper river — via the falls of Paulo Affonso within a week.

I also made an arrangement with Mr Krueger's Primeira Engenheiro, Mr to keep a record of the barometer and thermometer during our absence up the river. (Our aneroids to be compared at Sterling, and on our return.) Observations to be made at 6 A.M, 12 Noon & P.M — and 8 P.M. of the height of the barometer (its elevation above Sea Level to be noted) and of the height of the attached thermometer and also of the unattached thermometer.

Remarks concerning the prevailing winds, clouds, and the character of the weather could be recorded at the same time, the value of the observations would be materially greater.

The temperature of the wet-bulb of the thermometer, compared with that of the dry bulb would serve to indicate the hygrometrical condition of the Atmosphere at the place of observation.

This last paragraph was written

Upon then returned to Mr Krueger's house — Mr Seibora in Company — and had another excellent dinner.

After dinner I wrote up my Diary — and made the memorandum of the day in this book.

8 Friday—Aug. 22. Pittsburgh
Friday Aug 22. Cont'd Pittsburgh 9
We breakfast at 8. a.m. Nursing to start
sometime to day for Pittsburgh—
Rode in to Allegheny with Mr Mann and
Sister of the Parish and Mr Mann's
Mr Mann attended Parish to Perkins
Mann parish, during the reading Rev
Had brought gems - Mr Mann
arrangements for Mr Mann to
Had the Mann brought only 9 $, and
Mr Perkins 7 $ - The others given, for sale
were 2.5 $ Mr Kruger paid
on account 85 $ 000
Mr Meier took a note of the rates of the
man - The 12 who are to act as a Reunion of Lady
guards and Nurses are
while Mann is away attended
to Furniture a long letter to Perkins - Sister Mann,
Sent over to Mrs Margaretha McClure.
Mr Mann succeeded in breaking and starting
Aug 22 Parish Animals, Says he will again
33 Mrs Animals & Complete all.
We engaged Barb for 2 Cameras
and the mail Ford - 2 Cameras.
Concluded that engravings, cannot get
anything like about making Cameras - Mr Mann
Left about 5 P.M. Mr. Krueger Mr Weiss and
Mann out to the House and Ford Chairman.
After dinner Mr Krueger left Mr Perkins
and finished outs Mr Curtis Mr Parker
with Instruments.

Tuesday Aug 19th
Due Meyer Diary—
Obtained at Engineer's
Office in Tarentum as
follows:
July 1879
Level Lowwater Jacobs, 281.5
Nov 12, 1878 " " Reynolds 31.1
Difference 82.11
Morning 250.5

Bought of Mrs Davis Diary—

Sunday – Aug – 23d – Olio d' Agua

Backed Pirtino Opene,

At 6½ a. m., McKnight, Barcellos, Platino, Pereira, Henrique, and I, mounted our horses and rode back, over another road (about the Length of the one we rode last night) to the Railway line over which we had passed along in the dark.

We rode along along some distance with much pleasure & rode at appropriate Many – Landscapes; but the heights of the openings of the Coarse Cubute is much greater than necessary.

Time used for Mortons height 12 mins.

Cost 2,120 per annum (clearance). Mr Derby knows & how deep the Limestone formation, when this line is made; and doubtless he has done so.

We soon came on the 2 per cent. grade on a piece of line, principally finished, and well located, and the Cuts & fills are good, the Ogneous stone rock prevails along here; but I saw one excellent earth borrow pit.

The Summit Cut (referred to page 11) is about ⅔ done – in Amt. of Labor; and three fourths of the quantity of material a Considerable amount of earth being in the Excavation or Cut from Piranhas –

The 2 per cent. grade stops before reaching the Cut, getting out Level for a short distance & then a 2 per Cent. descending grade begins and runs through the whole Cut. Road about 2 Kilometers beyond the deep Cuts to the Station – Olio d' Agua.

Mr Barcellos says that 2 Sections Maccacos (whom I saw) and 40 men have done all this work in 7 months beginning in January. I am surprised at the quantity of work they have done – having only hand – Carts; which are very scarce and



Ht. 315m [K. 25.] 247m Olio d' Agua 314m Highest Summit [K. 27] K. 33

Descending Continuum 2 per cent grade from Ht of 315m to Sta. Olea d' agua – A fine undulating Scene.

6 Kilometers from Olio d' agua to the highest summit (4 metres higher than the one we examined) before breakfast.

Returned to Olea d' Agua to breakfast at 8½ – Breakfast 9¼ –

I am not quite sure that the location of grade and position of line in passing the summit we have examined is exactly the best – but from the statement of Mr Cox and Mr. Barcellos, it is but through the lowest depression of the ridge. I cannot safely criticise it accurately – though it is a big cut. It has been remarkable well worked & much done in 7 months.

We had intended breakfasting ahead at 10. a.m. but Breakfast being ready we stopped & breakfasted at Olio d'Agua

Left Olio d' Agua again, after breakfast Mr Platino Divisa Engineer accompanying us Mr Barcellos, Chefe de Secção, who was with us from Piranhas, parted with us here, and returned to Piranhas.

at 11½ a. m. in the midst of a very rocky region Scenery – in some places Mounds piled one upon another with Large rocky Ridge Bluffs – At 11.50 we crossed the Rio Orick – no water, only a sandy bed Appears Coarse sand. Sometimes water flows here, but not in great quantity, and not long at a time – Bed 5 minutes, and 50 feet wide or greater – at 12.10 in sight Talhada. Where Mr. has his Engineer Station

Dr. Plotinho's decision ends about Rio Once – and Dr. Manoel Vol de gens. Mr Derby.

Our stop here must furnish breakfast have been ordered here for us and they waited till quite late.

We took some cards or Cheese & Milk, gravel, They have also fresh butter too. We finished with a cup of excellent Coffee cum Lacte made in a patent French Coffe pot. [Mat. vol de Terra]

A good deal of the way from Olea d Agoa to Talhado the ground is favorable for the railway and for the Launds; but there are small depressions; and rocky places; the undulations where they occur are rather steeper than they appeared on the first few miles from Piranhas; after observing the gen- eral height of the plains

Talhado

We lunched in the house where the Emperor, and the Duke of Saxe Coburg passed the night on their way to the Falls of Paulo Affonso in the year – Milk, butter

Mr Derby says he was not to see the limestone formation, 3 or 4 leagues from here. He showed me a large specimen. It is a marble, quite white, streaked with serpentine and Lamminae of Sulphate of lime or of gypsum, as it appears to me. The lime that I saw along the line – deemed to be made from this stone is very good.

Our horses were unsaddled and put into the stable, being all hands a Drink. The Room is quite warm; but during stopping here a Breeze has sprung up which makes it very pleasant in the shade.

There is a fence now from the Porch of the House first of a Large dusty or open valley, then sloping hills then a higher ridge (red Sandstone) which we passed by on the same along, then a low mountain range



a few miles beyond to the S.E from here, At a distance the Mountains, hills and valleys appear as if covered with forest; but when near, it is seen that they are Hill only the Sertão – Scattering low trees, with Cactus in great abundance, and a thin sandy or rocky soil, almost every where. Only a few small exceptional spots, which have been cleared and Cultivated – a little, very little, Corn, and some vege- tables. Melons grow very well; but the people, the few who belong to this region, independently of the railway works, do not attempt to raise much of any thing except Cattle.

In the midst of the Scrubby trees and Cactuses there are grass and bushes which afford grazing, when the region is not devastated with drought. but the superficial appearance of the earth of the rocks, of the dry beds of sand in the bottoms of all the rivers, (showing that only at intervals, and for Comparatively short periods do they have flowing water in them) [There are two springs in the beds of these streams which would be killed were the streams to be flowing water Continuously, even for a few months.]

The great want and need of this Country is Water, and a deeper soil. (Probably if this were a rainy region the disintegration of the rocks might have been greater. If frost had been an accompaniment the disintegration would have been much greater.

The rocks, as a rule, shows very close near the surface, not only in the railway cuts, but all along the roads we travel; and all the ridges and Mountains are rocky. Along here they are Sand Stones.

The "limestone" about 12 miles from here, is a white marble, which makes good lime.

At 3.20 – We leave Talhado – Mr Derby & co. and ride 12 Kilometers – by the road, to Pedra – much of the way in sight of the railway cleaning The Dust was very Warm this afternoon.

16 Sunday aug 24 - Cont. Faz. da Pedra

Arrive at Pedra at 5.25 - and find the main body of the Commissão awaiting our arrival. Here we are to spend the night

Mr. Crockart de Sa Chefe de Secão. Livio dos Reis - 1ª C. Engrs

Beautiful view of distant - not very distant Montrai range - with Cultivation on the mountains and at the foot of the mountains - Pine trees seen through our glasses.

6.10 Darkness has come - Steps me, 6.10

Crockart de Sá - Chefe de Secção

Livio dos Reis (col.) 1.ºCl. Engr.

These engineers are in charge of the Second Seccão - which begins at the "Rio Orca" - where &c.

Our entire party - have a very nice dejeuner, with 3 Cadeiras to grace the table; Mrs Sa - Mrs mother in law, and Mrs - There were 8 at table.

A Cool, moonlight night with Venus setting and Jupiter just rising, and a delightful temperature, Closes the day. Our programme for to-morrow, after an early breakfast, is the Great Falls of Paulo Affonso - there to remain over night - and some time nearly all day. Come back to the Rail Road line.

I am provided with a comfortable bed; so, bidding all "good night" I am going to my Cabin. Good night

Monday - Aug 25. Fazenda da Pedra 17

6½ A.M. - Walk ¼ mile, or more, to the Pedra (Rio

Sandstone Pedra about 35 ft high on a flat sand plain Cabins with, smaller sand stone boulders. Cactus, small trees bushes, and gay hues Red earth tinges - on a rather light grayish cast Views within 100 ft. from S. Tomas Falls.



After making this sketch I noticed that much finer views can be had further off from the Pedra.

Returning to the House at 6.50, I am greatly amused at the efforts of a poll parrot to imitate all sorts of sounds; Calling "Anna, Anna! saying Propaganda - then saying now and a perfect portuguese tune - then Laughing - then it cried Mulana, then purr, mew, then Crying, like the baby - then the baby actually did cry - and the Propaganda Laughed. It imitated Crying wonderfully - then some portuguese words which I cannot get distinctly enough to read - then whistling birds - then, when some birds began making noise the Propaganda began quite a conversation. Now there are two parrots opposite each other Chattering away. These are large and handsome birds. It is said that there are plenty of parrots about here.

The mountain range north of us, is hid den this morning by fog. The real cries of the baby, and the awfully correct imitation by the Poll - succeeded by a hearty Laugh and more portuguese in a female voice, are startling. The poor child as represented by the parrot must be greatly given to Crying. It is the greatest variety I ever heard given by a parrot - and no one near it.

The fog began to fade away before the sun rose; but as we are to start about 8 o'clock it may not be sufficiently clear to get a good view with our glasses of the cultivation on the Mountain side, and at the foot.

7½ It is quite cool this morning, and Cloudy -

This is a very pretty situation; but a very large proportion of all the ground we see appears to be fit for nothing but grazing, owing to the scarcity of water and the thin (coarse sand) soil, the rocks here, as elsewhere in the region as far as we have traversed it being very near the surface.

The drinking water at the Engenio's House here is very good & rain water. But rain does not always occur here. This season is said to be exceptional, and the verdure which now prevails disappears.

It is said that they have good water on the mountain range, a few miles north; and I have no doubt this is correct.

Breakfast.

8½ a.m. I see now that there is village of scattered houses over at the foot of the above mentioned mountain

9½ a.m. We start for Falls of Paulo Affonso.

In One Kilometre we cross the railway Cleaning. and get on road to the falls. It is undulating land - stony near and at the summits. We found Scrubby trees, Cactus of several kinds, wild fig, and other previous and an emetine.

an occasional house - Sufferers Cattle rare

10.45 Rock is different - not ordinary sandstone from granite. We pass 5 minutes.

10.50 Rest.

11.05 Pass a Cluster of houses - with a pumpkin field. and water melons growing - Otherwise, no agriculture. Rock in places stony - in other places filled with debris of quartzose rocks - White quartz. There may possibly be a gold mine near by.

12.05) We arrive at Cazas Marcellinos - a Large Col.ª many with quite a family. The Casa is a quarter of a league about a mile, to the river - and about 3 Leagues to the Falls - Here we get a supply of milk fresh milk and Curds - and conclude to rest an hour or two. It is not a very hot day; but it is warm - There are Chimney flying and a few Tucanos Iraguas. It is quite pleasant in the shade.

The ground around here looks a little more fertile. We have passed Lagoons, with water, and a little water in them in Spots.



We remain at the mud edifice (Casa) of Sr. Marcellino 2 hours - resting and mostly pasturing the animals. During our stop the baggage Animals arrive and passed on.

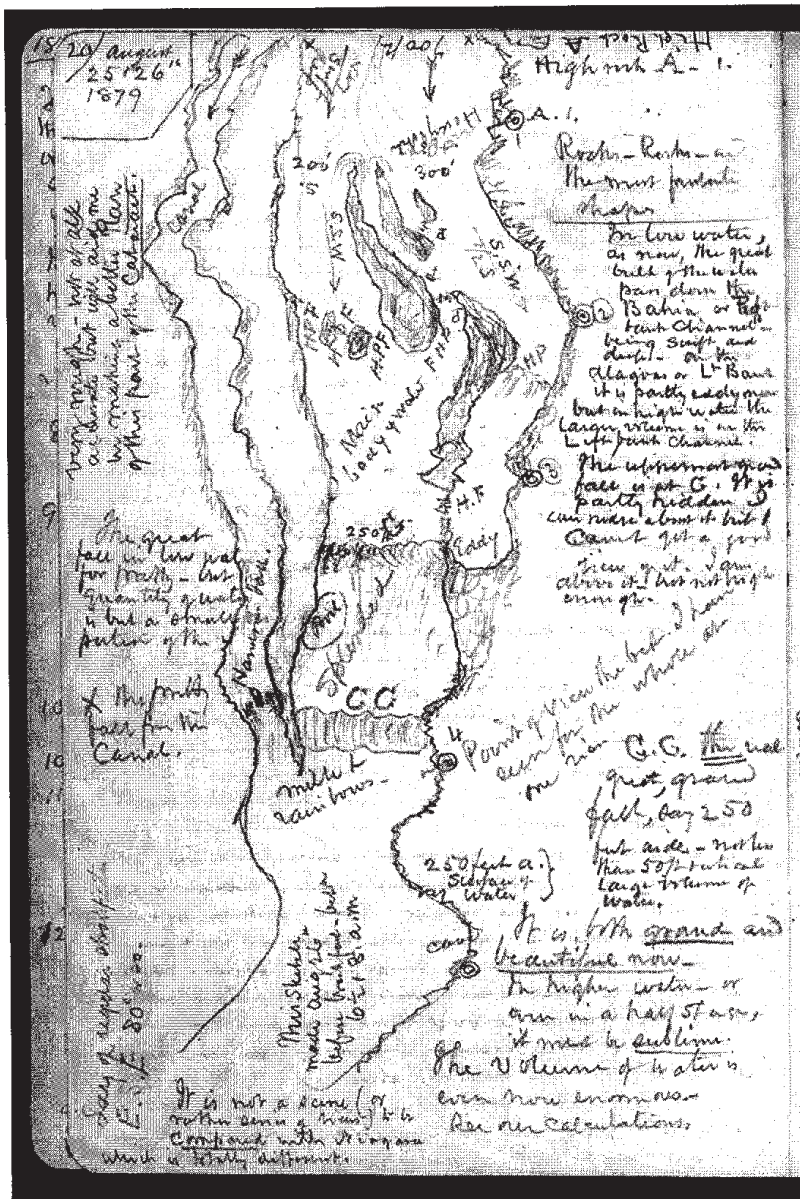
Two women were spinning Cotton on the usual primitive Style; without the intervention of a wheel. All done with their fingers. The Cotton was very white fine staple. The Cotton was raised at or near the foot of the Mountains in front of the Fazenda da Pedra, referred to before, some 15 or 20 miles from this Casa.

They raise nothing here but Cattle, & goats. They have very good milk and make some butter and some Cheese; but there is here no agriculture whatever. This place is within one mile of the S. Francisco River.

2. P.M. we start and ride 2 hours at about 5 miles an hour to the Falls of Paulo Affonso. Say 10, or 9 miles.

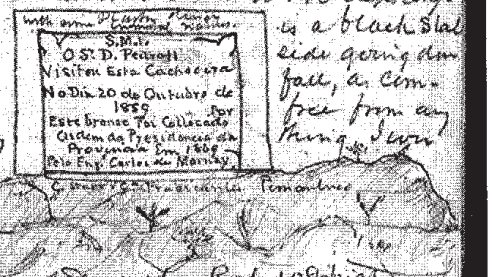
There are two mud edifices, one a Shop for sale - male - on poles covered with leaves for Shelter.

On the route we pass along in view, and for a part parallel with the rocky, Mts range. Same as Algoa nearly the same Mean Sandy soil, with near the surface Cactus, and scattering trees. For a few miles there was a stream of grasses - of two kinds on which Called is said to be the best natural grass in Brazil - The other grass called is longer and has a resemblance to our Timothy, though it is not timothy. Our Indians, who act as guide to those who have a guide, went ahead to see the view (as they think it) of the Falls, about a mile from our Camping place, silent, our camp. Camp is a short ½ mile from the brink above the Falls. I saw the view, but was disappointed that it was only a "side-show," and not the Great Falls. On our way to this we passed the monument put up in 1860 to commemorate the Imperial visit. Oct. 20. 1859. I was in Brazil in the Provinces of Rio de Janeiro, when the Emperor made this visit.




August 25 - Monday - Paulo Affonso 21

On arriving at 4, P. M. - at our Camping place we went on and soon back - to the nearest point an Indian guide - wholly unnecessary to us, in front some of our party having preceded us - and when on our returning - they thinking they now seen the Falls from what I had read and heard about these Falls I am satisfied that they could have had only a very partial view - at some one point; and so it proved. We saw The Falls, on the Bahia side, which comes from a Canal branch of the main stream - which is very pretty - divided by an island in the middle - a Miniature Niagara - and we saw the mouth of the Cave - which is near the whirl pool under the Falls on the Alagoas side. It is some 30ft. wide & 40 or 50 ft. high jumping from appearance from 200 ft above it - and it is said to be 140 Steps long. The Monument on the left hand the river from the falls, is absolutely useless, and artistic effort as any how. The Bronze pair is well enough. The rest is common Glazier work - as the



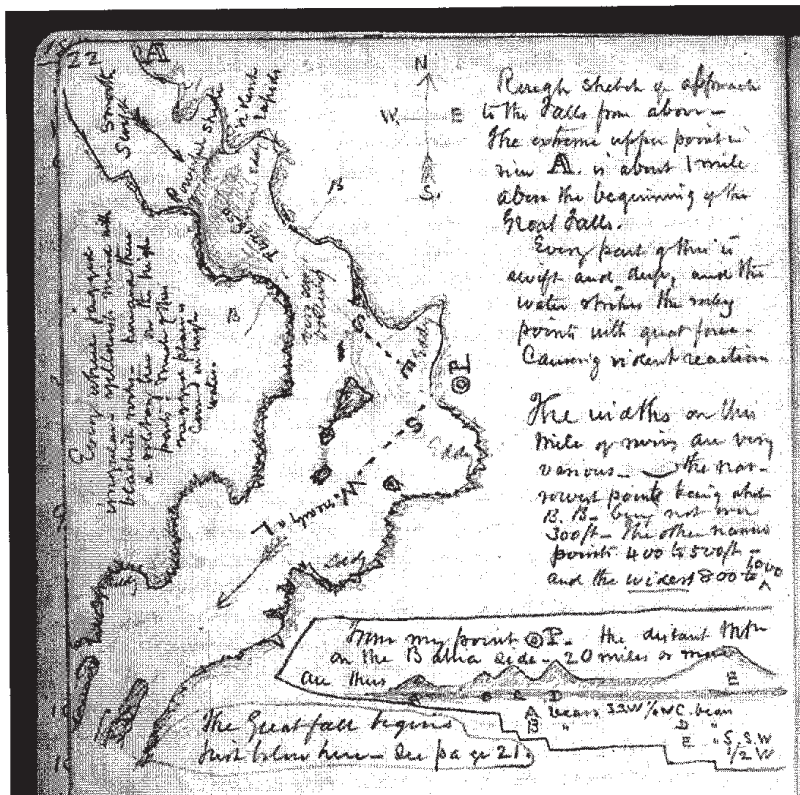

Stone steps from Rock 100 ft high

rocks - The rocks are artistic - or would be, if they were not entirely nature's work.

One good thing about this monument is that the President of the Provincia in 1859 - did not leave his name post upon the plate. Only the Emperor, Empr Morney and C. Starr & Co - appear by name - The Bronze is now a dull black. Originally I suppose it was pretty - It answers its purpose; but while they were about such a thing - Commemorating an Imperial Visit to the Grandest Natural object in Brazil, a more imposing and a more Characteristic design should have been selected.

The wadding, or stone throwing to get to points to view the Falls is about as rough a voyage as could well be found.

The water seems to have blackened the rocks. Black porcelain,




There is a vast volume of water passing here now, with the river in its low stage, though not at its extreme lowest. (It is called quite low)

When I took over this expanse of rugged rocks, which now confine the water within these comparatively (natural) narrow channels, and observe the evidences of the hourly greater volume of water, the increased depth and augmented velocity of the flood, [perhaps 6 to 8 times the present quantity of water— See future Calculations] I feel quite confident, that when the San Francisco River is in high flood, that here, along this mile of river, and including the Great falls



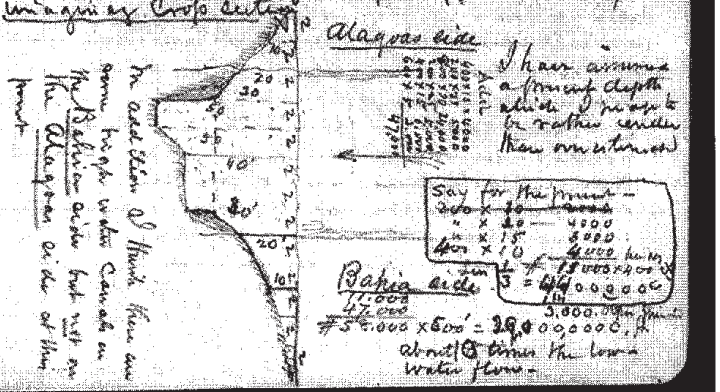
just below the present sketch is one of the very greatest of Natures Hydraulic operations.

On a much smaller scale, but still large worth seeing are the Falls of the Spokane River in Washington Territory, U.S.A— which I visited a year ago— The rapids, and the irregular falls constitute a miniature and softened picture of the perfectly rugged scene now before me.

The resistless power of heavy volumes of descending water are here very forcibly and graphically exhibited. One does not seem sure of looking at its ceaseless movements.

I levelled (with my eye) (5ft or steps) from the surface of the present water to a point where there are unmistakable evidences that the water sometimes flows in floods— and marks it 30 ft+. I think that it rises or has risen to a height of 35 ft at this point (or probably more) 35 ft. is the height of the rocky ledge which, at the same elevation, I made these notes,

It thunders half a dozen times during my stay here 1½ hours 10½ to 12 noon— and I made the body of the team 1½ to 1¾ of a dia. for shelter. The cross section of a 35 ft flood, any where along here for half a mile, would be quite different even at intervals of 100 feet. I can therefore only attempt a very rough approximate [illegible] of an imaginary Cross section




In cross section I think there are some high water Canals on the Bahia side but not on the Alagoas side at this point

I hear a rumour of [illegible] depth which I suppose to be rather smaller than our estimate

24 Tuesday – Aug 26 – Paulo Affonso to Moxoto.

About 1 P.M. our party began to assemble preparatory to Starting – which had been fixed at 2 P.M. Our Indian Headman is a native of the Head of the Itapicurú Rio, and the father of 10 Children – He brought several very fine watermelons – one of them a white one – which we discovered – I took also about ½ pint of Milk – This morning lost 85 Cows by a drought – he has 300 left. We have showers all the morning – It began in the early morn as a fine rain – It made the grass & bushes very wet – Inlaid snakes boots & pantaloons.

1.05 We start and ride up the river – Not exactly on a river bank; but on the irregular gently sloping bank, with stones & scattered trees – and not unlike Chances for Cultivating any thing. About 2 miles up from our Camp, It is a little better – There is rather more soil – and of a more clayey nature –

The river, off to our left, winds, and spreads into various channels, with rocky shores, and occasional rapids – One quite decided.

2.45 Our Leaguers up – we leave the river soon after having crossed a very fine Cow Creek, deep, the S. Francisco – in Bahia – At this part of the valley show Cultivation – and there is a little on the Alagoas side – A few miles from the river S.F. we strike the Moxoto river – which would be quite a Considerable stream if filled with water – as it is for long reaches. Now it is entirely dry – Some under Cultivation by the Colonos population Chiefly, water melons – In one place in saw Tobacco – The plants looked Unusually – but there had been some failure for a large Majority, and re-planting had been done.

4 P.M. We Crossed the dry bed of the Moxoto – 500 to 600 ft. wide – Sandy & clayey and we are now in Pernambuco – We now ride along

Tuesday – Aug 26 – Cont.d Province of Pernambuco 25

on the right bank or slopes of the Moxoto, in the Province of Pernambuco – We pass a out of a village of huts about 4¾ P.M. – Called

5¼ P.M. – my time – 3½ hours from Starting, we arrive at Moxoto – St. Sobato, Chefe de Secção's head Quarters – Where we are kindly received in a very good house arranged for the Engineers –

There are several other houses – not so good – and a small white Chapel.

There is to be a bridge here (152 + mills) about 500 ft. 5 Spans of 25 = 125 ft 2 of 20 = 165 5 of 82 ft. – and 2 of 65 ft each = 540 ft.

The bed of the River here is Sandy – That which I took to be Boulders, is, I suppose, the Irregular sandy bottom of the river.

In floods this valley has the appearance of bearing a large Volume of water. Best would hardly be safe in foundation of Piers.

Unless the Superstructure is Iron by Cheap per foot, it might have been better to have had Stone Spans; but I would not Criticise the Length of Spans adopted here – not hastily.

In this vicinity they raise Mandioca, Beans, some Corn – Cotton – & Tobacco, and Sweet Potatoes, and Melons; but not on a large Scale. Each man raises but little more than he and his family need. Cattle, Sheep and Goats – seem to be the principal Products.

It is quite evident that Xyes is what we call in the United States "a Thunder-gust" Stream. It rises while it rains, and for a little while after – and this seems to be the nature of any Tributary of the S. Francisco, as far as we have come.

* Very little Railway Fabrication this far Moxoto – or in Kingdom above Paranhas.

(26) Wed. Aug 27th Maxoto – cloudy –

We have arranged to go to day a short journey – to another station on the 3d Division, Sr. Lobato's

Our provisions brought in Piranhas and the boxes for the Canoes have not yet arrived – they were at Olio d'agua Night before Last. It is foggy on the Mts.

Our pack animals start at 7¼ A.M. – we will breakfast, and start later.

The railroad line crosses the Moxoto River just below here, with a bridge, as already described, it then makes a tolerably direct line for the river, striking it about half way between Moxoto and Jatobá – Jatobá is said to be about 32 Kilometres from here.

8¼ A.M. All of a Sunday we are Called to mount. It seems that there has been a misunderstanding the people here, as Mr Aniegu supposed, intended preparing breakfast, but they did not so understand. So we must ride 15 Kilometres (about 10 miles,) for breakfast – as our provisions have gone ahead with the packtrain. Well, I had an elegant cup of Chocolate and some little cakes early this morning. I'm all right.

We ride along in sight of the line much of the way crossing it several times, on sandy ground, smooth, very gentle undulations – Curves of large radius. There would be scarcely any work were it not that the rock is not far beneath the surface.

We stop and examine a water tank under the rock – it is about 20 ft diameter – and about 20 ft deep when filled – ½ full now – to catch the flow from rain. 130 C. Metres of rock were excavated – hard Sandstone.

We pass two other Tanks on the route this morning. The stone that was blasted out was built into a wall enclosing the Tanks –

These Tanks were necessary preliminaries to bringing men and horses on Construction.

Wed. Aug 27 | Moxoto to Quixaba (27)

So far as I can judge, and the opportunity of judging is very good, the Line appears to be tolerably Location –

About 9 or 10 Kilometres out we strike a small river the Rio Bananeiras – dry, of Course, and we and the line follow it for a Couple of Kilometres – then Line Crosses it and Curves to the right, while the Bananeiras runs off to the left and joins the San Francisco –

10.35 – We arrive at Station Quixaba – of the Engrs Mr Albuquerque – Chief of Section – in Charge – of Minim –

Quixaba – pronounced Kisha-baba is on the gently sloping side hill at the foot of the Serra do Capim. It is a Continuation of the Araripe (Serra) There is a portion or knoll of the Serra 4 or 5 miles from here back, called Serra do Braja. But there are no main range of the Serra Araripe.

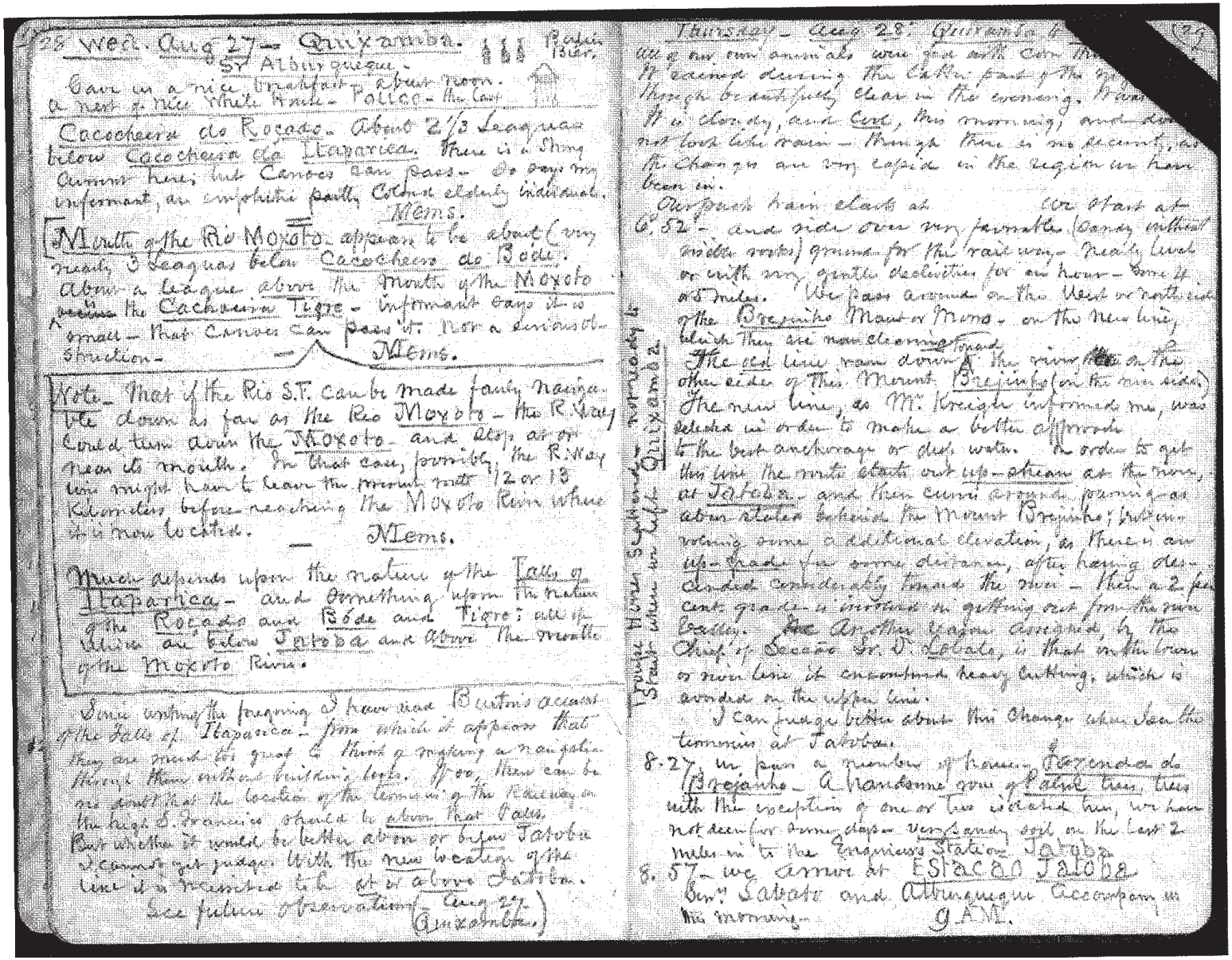
Memorandums.

The Cachoeira de Rocado – on the S.F River is about 3½ Kilometres below this Station –

The Cachoeira da Itaparica is about 8 Kilometres above here at (not above) a sharp bend in the river. The Serra Brejinho – Brejinho de Fora – on the left or Pernambuco side is just opposite the Falls. about 1 League below Jatoba.

The river just below the Itaparica Falls is very narrow, confined between Rocky Shores, but just above the falls the river is very wide 3 or 4 times as wide as the narrows – Canoes cannot pass the Itaparica Falls in the present Stage of the water. There is an island (there must be two islands) a man who claims to know says there are three Channels Mr Krauss's sketch or rough map represents an island.

Cachoeira do Bode – [Below which there is good canoe navigation to the smooth water above the Falls of Paulo Affonso. is about 3½ Leagues below the Falls of Itaparica, and the Bode Fall can be passed with Canoes in higher water.



28 Wed. Aug 27 — Quixamba. Rapids 1861.
St Albuquerque.

Camp on a nice Gravelly sandy Beach. Rapids
a mile & ½ below White Rock — Pottos — Fine Camp

Cachoeira do Roçado. About 2½ Leagues below Cachoeira da Itaparica. There is a Strong Current here, but Canoes can pass — So says my informant, an emphatic partly Colored elderly individual.

Mems.

Mouth of the Rio Moxoto appears to be about (very nearly) 3 Leagues below Cachoeira do Bode.

About a League above the Mouth of the Moxoto receives the Cachoeira Tigre — Informant says it is small — That Canoes can pass it. Not a serious obstruction —

Mems.

Note — That if the Rio S.F. can be made fairly navigable down as far as the Rio Moxoto — the Railway could turn down the Moxoto — and keep at or near its mouth. In that case, possibly, the Railway line might have to leave the present route 12 or 13 Kilometers before reaching the Moxoto River where it is now located.

Mems.

Much depends upon the nature of the Falls of Itaparica — and something upon the nature of the Roçados and Bode and Tigre; all of which are below Jatoba and above the mouth of the Moxoto River.

Since writing the foregoing I have read Burton's account of the Falls of Itaparica — from which it appears that they are much too great a Hindrance to navigation through them without building locks. If so, there can be no doubt that the location of the terminus of the Railway on the high S. Francisco should be above that Falls. But whether it would be better above or below Jatoba I cannot yet judge. With the new location of the line it is intended to be at or above Jatoba.

See future observations (Aug 29 Quixaba)

Quixaba to Jatoba

Thursday — Aug 28. Quixaba to [illegible]

All a new encampment was put with Corn [illegible] Received during the Cattle part of the night. Though he was [illegible] clear in the morning. Breakfast

It is cloudy, dark Cast, this morning, and [illegible] not look like rain — Mem. There is no accounting for changes are very rapid in the region we have been in.

Our speech hair clears at [illegible] Our start at 6.52 — and ride over very favorable (Sandy without visible water) ground for the rail way — Nearly level or with very gentle declivities for an hour — Some 4 or 5 miles. We pass around on the West or north side of the Brejinho Mount or Mons — on the New line, which they are now clearing toward

The old line runs down & the river on the other side of this Mount Brejinho (on the near side) The new line, as Mr. Keeley informed me, was selected in order to make a better approach to the best anchorage or deep water. In order to get this line the route ascends and up — a ream on the map, at Jatoba — and then curves around, passing on a broken plateau behind the Mount Brejinho; and then rising some additional elevation, as there is an up-grade for some distance, after having descended considerably toward the river — That is 2 per cent grade — is written in getting out from the river locality. See Another Report received by the Chief of Locação Sr. J. Lobato, is that in the new or new line it encounters heavy cutting, which is avoided on the upper line.

I can judge better about this Change when I see the terminus at Jatoba.

8.27 — we pass a number of houses Fazendas do Brejinho — A handsome grove of Palm trees, trees with the exception of one or two in front of them, we have not seen for some days — very Sandy soil on the last 2 miles in to the Engineers Station Jatoba

8.57 — we arrive at Estacão Jatoba

Bvr. Sabato and Albuquerque Accompany us this morning —

G.A.M.

G. A.M. At the Engineer Station – The Last.

We walk down about 1/3 of a mile to the river, and here it is a river, broad and smooth – not less than half a mile wide – with high sandy alluvial banks with little farms on both sides of the river; but looks to be more extensive on the Bahia or Right bank. The general valley is wide and open (except a few low scattering trees and bushes –

At this particular point there is a bluff some 20 ft high, with 6 to 7 Metres depth in front and for some distance out. It is a good place in low water or a medium stage perhaps; but I should think from the deeply water-worn jutting rocks that in high water there must be a very strong Current right here.

I walked down along the old line (which came up the river) for nearly a mile – and then crossed the river to the Terminus, below the Sand-bar which begins just below, & where there is a ledge of rock puts out, and where the river begins to bend to the left, descending. There is no obstruction or anything to break the smooth surface of the river; but I can see that sand bars form aside on this side and that the main Channel opposite here is probably on the Bahia side of the river, or possibly near the middle.

The only point unsettled in my mind now, is, whether a Terminus could have been had several miles below the place selected, without having more than 2 per cent grade after leaving the river? Whether there is a place as good, in low water, and as good, if better, in high water? If there is, and if the Channel is of sufficient depth from above to such point, it would save several miles of railway –

Jatoba Port – That so to be.

The place selected is at a point on the river where there is deep water (6 & 7 Meters) in low water – with a perpendicular frontage of rock ranging from 4½ to 5½ metres above the water, and behind that a sandy Clayey bank overtopping the rocks at a height of about 14 to 15 metres above low water.



The river rises in floods about 10 Metres above low water – so that the level of the flood line is 5 metres above the average height of the frontage of rock – and as the railway grade is to be 2 metres high – the grade will be 7 metres above the average rock frontage. 2/409

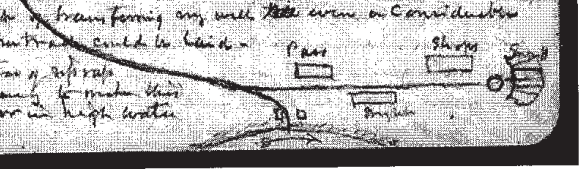
This rock-frontage has a gentle Concave curve – say 50 ft round in 400 ft Chord. It may be less or more –

In low water also a point of rock, which juts a little into the river, takes the force of the Current, and helps to make it Comparatively Calm opposite the rock frontage. The great width of the stream and its depth, on the Pernambuco or left bank side, also slackens the Current, and here there is little fall in the river. The river shoals towards the Bahia or Right bank.

There is a point on the Bahia side about a mile above Jatoba which throws the water over to the Concave Pernambuco side – Then the rock frontage at Jatoba helps to throw the Current over to the Bahia side, and Mr. Keeling says that the Channel does not get back to the Left bank before nearing the Falls of Itaparica. That it Continues shoal & without a fit harbor all the way down from Jatoba to the Falls of Itaparica. If so, then there can be no doubt that the proper place for the Terminus on the Upper San Francisco has been selected.

The approach to it behind the Morro Brejanho, is clear & around in front where it was first run, is shorter and has less work, and not having more than 2 per Cent grade in getting out from the river, is probably the better location.

I looked at the ground for the approach from the new direction – Mr. Wesson suggested a vertical instead of an inclined front for present purposes of loading and unloading from between cars and boats. A simple crane will do all the work of transferring any small [illegible] between – and then [illegible] could be laid –




A breakwater of rocks may be put in front near the water line so as to make a safe harbor in high water

Thursday – Aug 28. Rodonde – Atalha –
[Shower, during the day.]

We leave Jatoba at 2 P.M. arrive Opposite Rodonde – about 3.45 – and at Atalha at 4½ P.M.

Jatoba at present is Nothing – Sings quarters nothing more.

Rodonde – Consists of about half a dozen houses scattered – Amounting to little more than nothing. We did not stop in Rodonde

Atalha – is less than Rodonde – and more than Jatoba. The Caza of José Manoel de Souza, is the principal and only house of business, apparently. He says there are 2 small Canoes here.
He says a Canoe can go down to Itapanica Falls & back in a day –

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Thursday – Augt. 28th – Condender with a dozen others by Camp-light under the porch of our new friend José Manoel de Souza. and passing with our friends, Mr. Krieger and Mr Lobato Chefe de Seccão.

Mr. Krieger started at 9 P.M. with Mr Lobato – taking with them my Letters – One to Sr. Plinio the other to my wife. It is a fine moonlight night – and they will ride to Quixaba in 4 hours.

It rained during the night, but not hard.

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† Rest of the views are grander, much finer than any of the pictures I have seen here. Compare this rude admirable sketches.
All of the Commissão are well, and love Dolly the Geologist.

Commissão Plinio Atalha, above Jatoba on the S. Francisco River aug 28th 33

5½ days!

We left Piranhas on Saturday, August 23rd and arrived here this evening. Mr. Krieger who has accompanied us all the way, intends returning to Piranhas to night and I embrace the opportunity of writing – Mails go only Monthly.

I will first mention, that Mr. Krieger and his staff, all along the route, have attended to the members of the Commissão with most assiduously, our journey this far, has been made as pleasant as possible. We have viewed nearly the entire line of Railway, and we have seen the work that has been done for accomplished, besides having the great pleasure of viewing the Falls of Paulo Affonso on the afternoon of the 25th and morning of the 26th. The Falls exceeded my anticipations. I viewed them from five different points, and several of the views are grander, much finer than any of the pictures I have seen. † See back one leaf

Last night we slept at Quixaba – and breakfasted about noon to day at Jatoba – the Last Station of the Engineers on the Paulo Affonso Railway – Our main Pack-Train is behind, but expected to reach here tomorrow –

at Jatoba there is nothing whatever except the Engineers Station house –

Rodonde has half a dozen mean houses and Atalha consists of a few huts and one boat-house José Manoel de Souza, who does the little business –

The Country thereabouts for miles scarcely any thing.

One Man who went to Cabrobá to get Canoes for us and our baggage, is expected back to morrow – Meanwhile we are encamped here and will start for on the first to morrow – I will write to Ary as I pass by and write Opportunity or day or two later. I wish to more carefully about these things.

Original of Letter to the Minister Sinimbu, dated at Atalha, Province of Pernambuco, August 29. 1879.

# We left Piranhas on the 23d of August, accompanied by Chief Engineer Kreiger, who was both guide and friendly adviser, to whom, and his staff we are greatly indebted for many attentions which rendered our journey agreeable.

All the way we travelled either along the cleared route of the railway, or along the road generally in a new and near line, excepting only a portion between the Fazenda dos Pedras and Moxoto. We went from the former to the Falls of Paulo Affonso and came from the Falls to Moxoto passing for some distance up the Valley of this dry stream, in which there has been no flowing water for several years.

Having examined the maps and profiles, I have seen substantially, the entire line of railway as located.

The Location. The location of the line has been made with care and intelligent judgment. I have in my previous letter referred to the first ten kilometers. The early pioneers who established the road between Piranhas and some point on the lower and the upper San Francisco, seemed to have located a very general route. This was the basis for Mr. Kraussis preliminary studies for the line of railway. Of course many important local improvements have been effected in the final location of the railway line. I am satisfied that Jatoba is the best point.

Construction. The excavations and embankments as far as they are finished, have been well made. They form a good bed for a first Class metre-gauge and at some future day, if deemed advisable, even a wide gauge track could be laid upon it. My opinion is, however, that for the metre gauge is the proper gauge, and that it need not be changed, to any other gauge.

The masonry of the culverts, beyond the first ten kilometers, is of a less costly character and more appropriate to the region than that near Piranhas. I would not have had any masonry on any part of this line; and I would have adopted much smaller culverts, of less height in proportion to their width; but these differences, compared with the main features of the railway, are of minor importance.

Along the route, at a number of points, I saw water-pits, which the Chief Engineer had caused to be excavated, to store up rain water for the laborers and animals engaged on the works; which I presume was a necessary precaution, as the whole region is excessively dry. The rains and showers which have occurred in June, July and part of August, of this year, have had no effect in restoring water to the streams crossed by the railway line, & they lay all perfectly dry and have been dry (excepting occasionally, after showers) for a long time - It is said that there has been no flowing water in the Moxoto for three years.

Water, great, meteorological, of all the region we have traversed from Piranhas to this point. Where rocks and stones permit any soil is very thin, and dreary; and for want of water, not capable of profitable cultivation. There are little patches, where melons and similar products are raised: but for corn, mandioca, cotton, etc, the Mountains on the one hand, and the very limited portion of river bottom that may exist along the margin of the stream between Piranhas and Jatoba - afford the only chance. Cattle, however, find pasture in the Sertão; and milk and a little butter and some cheese are made; but there is no inducement for a class of regular farmers to attempt a living in the region described.

Superintendence and direction of the works. The assistant Engineers on the line are all intelligent educated young men; brazilians; and they appear to be industrious and active in the performance of their engineering duties. I have been quite favorably impressed with the manner in which the work generally has been conducted by them, under the immediate

of The Chief Engineer.

The foremen, natives of the Country, have been well trained in working the Laborers to the best advantage that the Circumstances admitted of. Until quite recently, they had no animals, and all the hauling out of the deep-cuts, had to be done by men with hand-carts. They are only now beginning to work animals. Considering the fact that the work had to be done under such disadvantages, I was greatly surprised at the amount which had been done on the Reserve Deep-cut Excavation near Otiko d'Agua. I judge that it is two thirds done, and it was only begun in January. —

The road, for the convenience of the railway Construction, has been well located, and is well adapted to its intended purposes. On a large portion of the route it is good enough for the easy Conveyance of heavy Cargoes on Wheels; but there are places, crossing the dry valleys, where the grades is necessarily considerably more abrupt where the progress of a heavy Carriage would be more slow and difficult. I should anticipate that on this route, where the Cattle-forage is good, first class, and where the pasture is pretty thin, it will be a tedious and difficult task to get the Steam Launch along.

The Chief Engineer had given directions to have this road improved; and I saw men at work in places straightening and otherwise improving it. For the regular railway purposes, it is a very good common road throughout.

It was to me unexpected to see how well the ground generally is adapted to permit good roads, with little more work than the clearing off of the boulders scattered here and there, some of which are large,

In regard to the use of a steam launch drawing a metre and a half of water — which ought to be the case at least 1½ metres in the bad places, the opinion is that it cannot run at the present time; but I do not depend



upon this opinion; and as soon as we can get Canoes, I will have a surveying Party first between here and Jatoba, about 3 Leagues, and afterward as we work up the river, and I will communicate the result to Chief Engineer Kreiger.

At Jatoba, there is at present nothing whatever excepting the house of the Engineers station; and at Rio Verde, and here it is only a little better. Just for the Cattle, which range back from the immediate river valley, the people could not stay, as the river slopes are almost perfectly barren. Here and there patches of river bottom are readily cultivated; but in high water these are inundated. Yet people do manage to live here, and every inhabited house has a good crop of Children.

The Indian at the Pauls Affonso Falls, the principal inhabitant and guide, has ten Children. He lost 85 Cows, by the drought, and now he has only 30.

I apprehend that it will be tedious, rowing up against the current with such Canoe-men as can be Commanded. I can judge better after seeing what kind of Canoes we get, and after we transform them into boats.

In Case there is sufficient depth of water for the Pauls Affonso I would greatly rejoice if the Canoes could take us, and then and us in our further progress up the river.

The stream at Jatoba, and here, is wide and beautiful, nearly half a mile, and the river bottoms and slopes at a distance form pleasing pictures; but when close at hand their beauty fades away and nothing but stern, sterility remains.

The natural harbor on the rocky river front at Jatoba, is a favorable point for Connecting the Railway with the river. At its low stage the river in front is from 6 to 7 metres deep, and the face of the rock bluff above stands about 5 metres above the present low water surface. The river was about 10 metres in [illegible] at present accounts. Cannot [illegible] a medium [illegible]

(38) great flow-de, and the Railway Track will be about
three meters higher, or that a Stratum 7 Metres
high on the rock bluff-face will be level with the
road. The [illegible] has not yet
been decided upon by the Chief Engineer.
The rock rises back of the front, and above
that is sandy alluvial materials.
Over the ground admits of a good amount
Porto, it may be found advisable here-
after to project a break water out 30 or 40 yds
into the river, at a point some afew hundred
feet higher up, to protect the Harbor in high
floods. I judge that in high water the
great force of the river Comes from a point
above a mile above on the Bahia side
with great force against this rock front at
an Acute angle. The water surfaces and
holes in the rock shew the effects of a pow-
ful Current; but it was not in built now
at this the Engineer has seen a high flood.
I have written them fully in the hope that
our man, Porena da Cendrada, whom
Mr Kreiger sent to Cobrabo after Canoes,
may report, that tonight or tomorrow morning

Upon one point I can now speak with confidence;
A Canal, with locks, around the Falls of Paulo
Affonso (and the Falls of Itapanica and Regadeas
Entirely impracticable, not only on account of the
great first Cost, but on account of the Annual
Cost of keeping it in repair, and the delay it
would cause in transportation. The Circumstances point clearly to a Railway as the
proper mode of Connecting the upper and
Lower San Francisco. [Abatha Aug 31. 1879]

Since writing the foregoing I have made a personal examination
of the Cachoeira da Vargem Redonda. It is about the 3/4 the League
of Mr. Halliday map. It is swift water at the head and foot
of the rapids, but Light Canoes can work through, and the Falls
of Paulo Affonso could now be passed without difficulty. The river here is about
two palms above extreme low water. We have no word yet of any
Canoes from above, nor any news of the Falls of Paulo Affonso.
[illegible]

Friday Aug. 29. Abatha. Oh! (39)

I awoke this morning about 6 o'c, with a miserable feeling of stuffed head - which I
ascribing to stuffing my stomach yesterday, and
smoking and bothering and some water melon -
I ate a moderate breakfast (and I had
walked around a little before breakfast)
The residue of our troupe Came in this
morning except the Boards, which are to
Come by an Ox-team and big wagon, and
we now have all our Musicians - and the
Foreman Gomez da Costa of our 12 men -
he being one - who act as our Militia guard -
though they are not soldiers.

I devoted the residue of the day
when not in Consultation with Mr Keizer, Mr
Derby and Mr Lisboa others, about what
Surtheá done here & writing a very long
Letter to the Ministro - Secretario - a high
draughts of which is in the preceding
pages. I took it and copied it to.

P.M.
4.50. Our host, a neighbor José Manoel de Souza
who told us about a medium size Canoe a
few miles below, has just been to see me and
says it has a whole in it, and if that was
mended he thinks it would be suitable for
purpose of taking over dos Vigo; so I suppose we
must wait till we get Canoes from above.

I directed that measurement of the width
of the river should be taken at this place to day, by
two methods, partly for the purpose of knowing the
width, and to test the instruments; and to give the
young engineers practice.

5. P.M.
I have felt uncomfortable all day; with a partially
stuffed head, and in the morning four bowel discharges.
About midday I took a dose of effervescing powder
Pyretic Saline (Potash & Soda) which helped a little
to clear my head.

At the friendly Caza of José Manl. de Souza a
on Camps. Last night I retired early. Was
quite ready most of the night. I soon frequently
awoke and dreamed a great deal, and my head
did not feel Comfortable. After being up some-
time reading this morning, and reducing Burton
Vol II - I have taken another dose of the Pyrethe
Saline. I do not yet (as know after) feel much
effect from it. My head is still stiffish. My
bowels are quiet as yet.

Breakfast about 10 - just previous, I took a second
dose of Pyrethe Saline, which, with the breakfast, now
eaten in Amount, seemed to relieve my head Considerably.
At 11. I Concluded to make a personal examination of the
Cachoeira Verzea Redonda - about a League below
Atalha. Sr. Gomes da Castro - our Fornan with us.

## Cachoeira Verzea Redonda. Mr. de Souza so Styles it.

This is about the 314th League of M. Halfold, which he
Calls Cachoeira da Vargem Redonda.
M. Halfold's Map of this Rapids (or Falls as it
might be Called in high water) is on a Small Scale
and Conveys a very inadequate idea of the place
as it appears now, when the water is within 2
Palms (So says Sr. José Manl. de Souza, our guide
this day) of its low stage; 18 inches above extreme
low water.

The rapids from the upper end of the Reef
which runs across the river, nearly at right
angles, to the Commencement at the foot of deep
water below occupy nearly a mile. The river
itself is nearly half a mile wide above the rapids
and quite wide in high water along all parts of
the rapids narrowing below along the rocky wall
on the Bahia side or right bank, but soon widening
to a fine clear navigation, which Continues good
depth for any vessels that can navigate this river
above the Falls of Paulo Affonso, all the way to
Jatoba, the upper terminus of the railway now
under Construction.

The river channel above these Rapids is on the



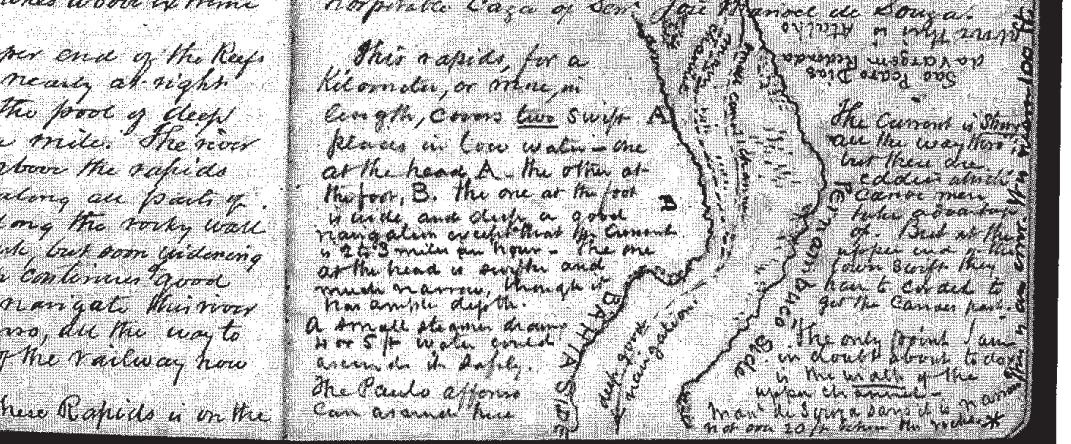
Bahia side - (through there is another Channel for
light Canoes down near the middle of the river in
low water, as it is now.

M. Halfeld gives no soundings or Current
rates at this place, nor any below this.

There seems to be a hiatus in M. Halfeld's maps
about here. Sheet No 26 ends at League 321½, about.
Sheet No 27. begins at " 339
missing - according to this * 18½ *

At all events there are no soundings or current rates
given on any of M. Halfeld's maps that I have, between
League 314, above the Cachoeira da Vargem Redonda
& near Piranhas about league 339 - along a dis-
tance of 18½ leagues.

I understand that this point, da Vargem
Redonda, has been Considered as the lower
end of the Upper San Francisco - where it has
been Customary to embark and disembark; although
the Canoes Can run down as far as Jatoba,
but have some work to get up through the swift
water near the foot of the rapids - and also at the
head, on the Bahia side. This is where Captain
Burton ended his interesting journey, and made
his return to the Upper San Francisco, at the
hospitable Caza of Sen. José Manoel de Souza.




This rapids, for a
Kilometer, or more, in
length, Comes two swift
places in low water - one
at the head, A. the other at
the foot, B. the one at the foot
is wide, and clear, a good
navigation or rapid - Current
is 2 to 3 miles per hour - The one
at the head is swifter and
much narrower, though is
has ample depth.
A small steamer draws
4 or 5 ft water could
ascend in safety.
The Paulo Affonso
Can as cannot here

The Current is strong
all the way here
but there are
eddies where
Canoes may
rest & so descend
Cr. But at this
upper end of the
lower Rapids they
have to Cordel to
get the Canoes past.

The only point I am
in doubt about to draw
is the width of the
upper channel -
Man' de Souza says it is as
not over 20 ft when the water*

Sat. Aug. 30. Atalho and Redonda

Continuation of Cabeceira da Varzem Redonda

The rise & rocks remaining substantially the same from year to year, the Channels at any given height of the water remain the same; but the movement of the water and the precise direction of the current through the natural Channels vary with the varying height of the river; so that the main Channel which in a low stage of the river is practicable for the ascent of Canoes may not be so in a considerably higher stage.

In Low water there is a large area on the Pernambuco or left shore, over which the rocks project with utmost irregularity of height and position, which in a medium or half flood, are overflown, and which owing to their rugged character create a violent turmoil of the water. With every added metre of depth the current becomes stronger, and in high stages of the river only a steamer with the proper power can stem the current.

Even for descending Canoes a considerable increase in the depth of the flow renders it necessary to be careful and watchful in passing through the Channel.

—

The river here begins its annual rise about the beginning of Nov. It does not rise continuously, but fluctuates, sometimes falling, sometimes rising faster.

About the Latter part of January or in February it attains its height. The height varies considerably in different years.

It usually continues at a high stage, without material falling till about the first of April.

From that time it fluctuates (rising & falling); but gradually becoming lower till October, when it is usually lowest.

In June, July, August and September, it may be considered to be low, though not at its lowest stage till October, and is good navigation for Canoe boating.



Sunday Aug 31st 1879 Atalho, Province of Pernambuco

Illm. Exmo Commendador

Senhor

Publicas

José Wilkens de Mattos, Director Obras, Rio de Janeiro.

Your Officio, dated August 9th 1879, received here to day. It encloses the bill of Senr. O. C. James, dated July 31st 1879, amounting to 39 and [illegible] & most of the items marked with red ✓ are proper to be paid by the Government.

Before leaving Rio de Janeiro with the Expedition I understood that the expenses of the Commission, including pensions, were to be paid by the Government.

I was not aware that Gratuities were to be paid, to be paid to the Engineers. I learned that afterwards. I did not know what the Customs were, and I only intended to carry out the instructions received from Commendador Pinto.

My duty is to conform to the customs of the Government. Is it the Custom to allow a deduction on ordinary expeditions, to the Engineer in Chief?

If so, what should it be.

I have, however, the deductions of the other members of the Commission will be as follows:

| | |
|---|---|
| Pimenta Bueno Engenheiro | $ 8. |
| Chefe de Secção | 7. |
| 1st Class Engo. | 6. |
| 2d Class Engo. | 5. |

I enclose herewith another bill, together with the original bill, Corrected in accordance with the marks in red on the original bill. As all the articles were ordered through Sen. James, and passed to be for government account, there is no way of determining precisely what portion of the items marked thus ✓ belongs in the bill. I have assumed it at one half.

I trust that my actions will be regarded as satisfactory,

(44) Sunday Aug 31. 1879. Atalho.
Continuation of Letter to Minister Sinimbu.

I close this in order to take advantage of an opportunity of sending Letters to Pranhos by the hands of Snr Cavalcante Engo who to day brings Letters to us from Rio de Janeiro. Among them are from Commendador Millcens Mattos, returning our bill, for correction, and which I answer to day.

I have the honor to remain
with the highest respect
Your obedient servant
N. M. R. Engr en Chefe

P.S. Snr Cavalcante left before my Letters were quite ready, and I write these by another Person.

Atalho, Pon. of Pern.
August 31. 1879.

Illmo Exmo
Commendador
Snr Dr Luiz Plinio d' Oliveira.
Secretario de Am

This morning, just after finishing my Letter to the Minister-Engineer-in-Chief I had the honor to enclose herewith, the Messenger, sent by Chief Engr Reis from Pranhos, (I understand) that he had sent an agent, with authority to buy or rent Canoes and get them down here to us/but [illegible] on inquiring of him we could see us nothing definite about Canoes in Cabroba. He brought Letters from Cabroba in answer to Letters which he had Carried from Pranhos, from our friend Venturo to Srs. Fortunato Francisco dos Santos, and Vigario Ant Jose Ferreira de Moraes, about the Canoes. The Letters were sealed; but under the Circumstances I called a Council of War and opened, and with

Letter to Comr Plinio Continued (45)

difficulty had them read, so as to understand their Contents.

They amount to this: that at their date Aug 25, there were no Canoes there that would answer to be had. That possibly, by the end of August or beginning of Sept there might be some few come back to Cabroba which were then up the river, but these seemed to be no Certainty about any thing; and the Letters suggested that some person with proper authority, etc, should go up to Cabroba to make the necessary arrangements, for buying hand, etc.

This is the very thing that I understood the Agent from Pranhos was to do.

However, he done me; and
As I cannot bear to remain here idle, I have determined to procure canoes and push on the provisions, in this vicinity, and push up this river. To day some small Canoes have appeared for the first time on this part of the river, coming from above, and on enquiry I find that a few more are coming down the river. On my arrival at Cabroba I will send one of my staff with a man and a guard up the river, with authority and funds to buy Canoes, any where along the river, if found serviceable, and send them down to meet us. I have hears from the aforesaid Messenger, that there are Canoes along the river for the next 12 leagues; so that possibly we may receive them this side of Cabroba - and save much time.

The river is within two palms of its least stage and in a favorable Condition for our communications. Even if our progress may be slow for some time it is better to be going than to wait; or to depend upon doing any thing through mere messengers.

We have no word of the coming of the wagon, with boards for making Canoes into boats; it also contains some other things which we need [illegible]

Cofre for wagon shall have delivered the things at Palestra, or else either have to take Canoes down to bring the things up, & send packs accordingly to fetch them up.

The days are growing but the nights are cool, so that in the tents we find blankets a necessity. It rains most of the time, and many streams up there; but to an Australian friend José Maria de Souza says they don't see rain here at all, and even bird and fish that they don't know how to use them.

Had some rain made in Brandão's letter the title of Gente, a different story, and fortunately I succeeded in even the limited how to handle — and I know something about handling rain myself.

Upon the receipt this morning of Commandador's letter returning M.D.C. Dames bill for Circulation, with a large portion of it marked as not allowable by the Government, the Commission was rather surprised. I had not clearly understood the matter at first, thought I understood from what was said, that the ~~of course~~ [illegible] would be furnished by the government for this expedition. Supposing I could obtain [illegible] I began to make a contract with Dames, which I now intend to go to Rio de Janeiro by the same mail with this letter.

Perhaps some of the articles may have been stricken out of the bill which you had intended should be at the cost of the government. Under the original bill amounting to 3690$ to Engineer Millers of Mattos along with the Contract bill 1253$ Whatever the government Cannot allow, we supply of course from the Commission. I think it obligatory on me to obey instructions, and conform to the government rules, in spite of the Commission.

Under the advice of Chief Sage Stenger, we did not take Indians, but employed



12 armed men, extra ones only when work is needed, one of whom is a good foreman. Eleven of them have families, whom Mr Briggs will attend to during our absence.

We also by his advice ~~from~~ and that of our friend José Maria Pinchard Coronado, entitled of Pinning them; and it is true that on the 30, for we are no part with Till we are ~~other~~ spread on the river.

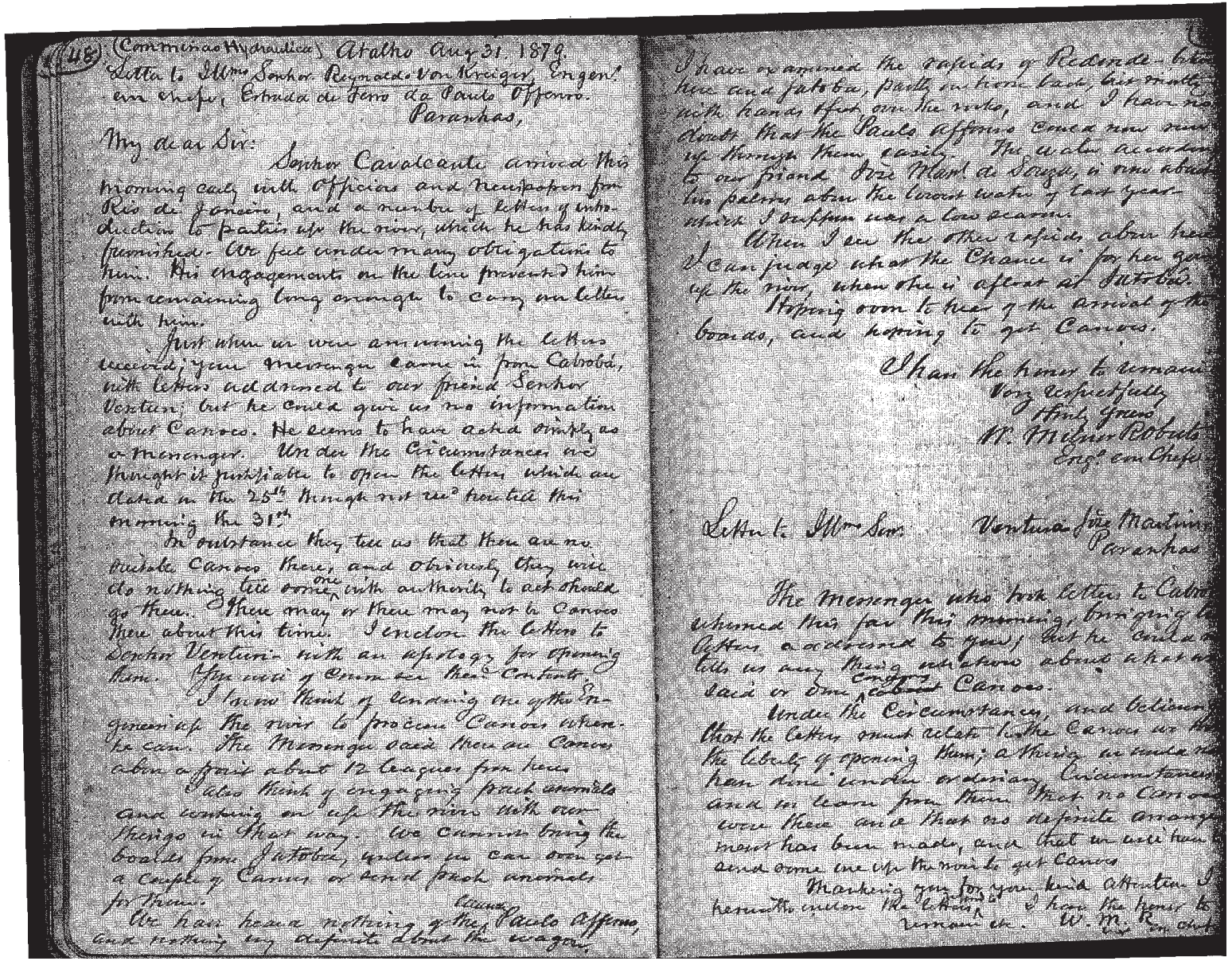
We are here in front of a beautiful river. Its width was measured yesterday and found to be one 7460 metres, or 24600 feet. Its navigation at the age of 2500 feet. We are only 197 ft. less than half a mile. In place it is over half a mile.

The only obstruction above Tocotoca, to this place, and for some leagues above here is the Cachoeira da Vargem Redonda — about a league below here. The Paulo Affonso could run up it now without difficulty, although there is a strong current at the head and foot, with a good depth of water.

We are not quite prepared to take a complete section of the river for want of a proper Canoe, but the volume of water now running in it (though not its lowest) stage is very great.

This is a very important fact as it encourages the idea that a fair navigation may be obtainable at the rapids.

If the rapids are are caused by reefs of rocks, as they are this year, the channels will not be fluctuating, when once found. Many of the rapids are and American man says nothing but gravel, or sand and gravel, and subject to change in a few floods; but I must see a number more of the rapids higher up before forming any general plans. The bars, as they run, so far as I have seen them, are all good.



(48) (Commissão Hydraulica) Atalho Aug 31 1879.

Letter to Illm Senhor Reynaldo Von Kreiger, Engen.
em chefe, Estrada de Ferro da Paulo Affonso.
Paranhas,

My dear Sir:

Senhor Cavalcante arrived this morning early with Officers and Newspapers from Rio de Janeiro, and a number of letters of introduction to parties up the river, which he has kindly furnished. We feel under many obligations to him. His engagements on the line prevented him from remaining long enough to carry our letters with him.

Just when we were answering the letters received, your Messenger came in from Cabrobó, with letters addressed to our friend Senhor Ventura; but he could give us no information about Canoes. He seems to have acted simply as a Messenger. Under the Circumstances we thought it justifiable to open the letters which are dated as the 25th though not received until this morning the 31st.

In substance they tell us that there are no suitable Canoes there, and obviously they will do nothing till one arrives with authority to act should go there. If there may or there may not be Canoes there about this time. I enclose the Letter to Senhor Ventura with an apology for opening them. After all of Crossan see them Contents.

I have Think of sending one of the Engineers up the river to procure Canoes when he can. The Messenger said there are Canoes above Affonso about 12 Leagues from here.

Also think of engaging Pack animals and sending on up the river with our things in that way. We cannot bring the boats from Jatobá, unless we can soon get a Couple of Canoes or send Pack animals for them.

We have heard nothing of the Paulo Affonso, and nothing any dispatch about the Seagoing

I have examined the rapids of Redondo - between here and Jatobá, partly on horseback, but mostly with hands & feet on the rocks, and I have no doubt that the Paulo Affonso Canoa can run up as high as Pedra Branca. The water according to our friend José Maria de Souza, is now about two palms above the lowest water of last year - which I suppose was a low season.

When I see the other rapids above here I can judge what the Chance is for her getting up the river, when she is afloat at Jatobá.

Hoping soon to hear of the arrival of the boats, and hoping to get Canoes.

I have the honor to remain
Very respectfully
Your friend
W. Milnor Roberts
Engr en Chefe

Letter to Illm Sen. Ventura José Martins
Paranhas

The Messenger who took letters to Cabrobó returned this far this morning, bringing back letters addressed to you; but he could give us no information about Canoes. He seems to have acted simply as a Messenger and knows about what he said or done Canoes.

Under the Circumstances, and believing that the Letters must relate to the Canoes we thought the Liberty of opening them; & Having as under ordinary Circumstances have done - under ordinary Circumstances would not learn from them that no Canoes were there and that no definite Arrangement has been made, and that we will have to send one up the river to get Canoes.

Thanking you for your kind Attention I have the honor to remain &c. W. M. R. Engr en Chef

50

Cotalho aug 31
Letter to C. C. James. 1879.

My dear Col:

This morning the Hydraulic Commission rec.d an Officio from Commendador Wilkens de Mattos Director Obras Publicas declaring that more than two thirds of the bill is made and which can not be allowed by you on the 31.st July Could not be allowed to be paid by the Government; marking in red the articles so dis allowed.

Accordingly I have had made out a new bill of the allowed articles amounting to 1243$ which I herewith along with the original bill to Snr Mattos, I have also written to Sr. Plinio, upon this along with other subjects.

I don't know enough about these matters here to judge how it will end but it looks as though we will have to pay a Considerable part of the cost of this expedition out of our own pockets. If Even if the government don't pay for us now.

The dam has gone down and I am writing in the last by the light of the Clerks. I have so many letters to write that I must hasten to close.

Do not mention any thing about this proceeding to them it only annoys them for nothing.

We got no private letters last, even expect to by 10.th Came to Lisbon Dutch as before for the present.

We do all well.

Kind regards to all

Yours very truly

Edwards de Jno de Mones

H. Milner Roberts

51

P.S. I have one letter to add, that you opened from Edwards de Jno Mones (Engenheiro) but I have not read the pamphlet which he mentions as the pamphlet which he mentions as I am sending it. I can read it if you have sent. I cannot possibly read this letter till our mail Comes in to-day.

Yours

Letter to D. Manoel de N. Adm.ra

Adm.or e Crear.o

Edwards de Jno de Paulo Affons

Peranhas.

Dear Sir. Your letter dated August 29.th came this morning with the correspondence by the hands of Senhor Cavalcanti. He could not wait for an answer to letter to go with him, and we will send them by another.

Your mistake in opening the letter addressed to me, was quite natural and I think nothing of it, feeling perfectly assured that it was entirely accidental.

The members of the Commission with myself are all glad to hear from you, and join in sending kind regards to yourself, the other gentlemen in Peranhas

With much respect

Yours truly

H. Milner Roberts.

52 Letter to Lenker. Ataliba Aug 31.

Eduardo Jose de Moraes
Engenheiro etc
São Paulo

Dear Sir

Your Letter dated 30th of July, came to day ^ via the mail bringing offices from the government requiring immediate attention, and I have only time to glance at it now and get an idea of your wish, before the mail goes.

It is possible that your pamphlet is among a large number of books & pamphlets which I intended bringing with me to read during my travels along this river. Our baggage is partly here and partly on the way; as soon as I can have the opportunity, will with pleasure give attention to your study; but perhaps it may not be in time to answer your present purpose.

The project seems to be an important one, and not having seen the place, I could not form a reliable opinion without a careful study of your pamphlet.

I regret that I did not receive your letter before leaving Rio de Janeiro.

I have the honor to remain
very respectfully yours
W. Milnor Roberts

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Conclusion of Letter to Engr. O.C. James

N.B. Mr Daby has been kind enough to look through Snr Moraes' Letter and I have concluded that it is better to acknowledge its receipt. I have a recollection of seeing the pamphlet but I am afraid it is left behind by Pyanhos with others, and impossible to get the thing before we return. Please read our Letter and seal and forward to him. "May Yankee Eng and prosper"

53

Sunday Aug 31. Ataliba.

See back to page 43 for

Letters to Ministro Sinimbu, Plinio, William Mathews, Mr Krieger, Ventura (Joe) Martins, O.C. James, Manoel de N. Alves Lenhares, Eduardo Jose de Moraes (São Paulo) Letters to Ministro, Plinio, and O.C. James in english - the Others in portuguese. Translated in Lisboa and Sabóia.

Wrote from 7 A.M. till 10 P.M.

Gen. Cavalcante was kind enough to leave with me Letters of introduction to persons up the river, as follows:

Boa Vista - Manoel Ignacio (Ingellio) d'Carvalho M.D. Col Superior d Boa Vista
" " Vicente Ferreira de Carvalho Vinheira.
Villa da Penha - Antonio d Amorim.
Pedro Affonso - Antº da Rocha Medrado.
Barra do Pajehú - Domingo Antº Rejadas.
Brandon - Estanato Francisco dos Santos.
Villa da Cobrabó - Antº José d'Andrade.
" " Cabrobó (?) " Antº José Firmino de Moraes
" " Antº José Soares d Mello Arellano.

To day Gen. Lisboa and Sabóia went in a Canoe, with our friendly pilot, Manoel de Barros, as pilot and Canoe-man, (at my suggestion) to examine especially the Front or Section of water between the ends of the Upper end of the Cachoeira da Vargem and Redonda. They report ample width 50 or more metres between the rocks, and good depths, with strong Current - perhaps 5 miles an hour, in mid Channel. They went down to the pool & Whirlpool below the foot of the Rapids, and returned up obtaining through the smaller, or Canoe Channel, nearer the middle of the river.

I propose to make a final personal examination of this Channel tomorrow; it will require only a little time in the Morning to send off the Correio or mail to Piranhas, and to arrange for some one of the engineers to go up the river to buy Canoes.

Monday, Sept. 1st Atalho- Showery-

About 8. A.M. sent off our Courier "Andrade" on foot, with our mail for Piranhas enclosed in one package addressed to Chief Krüger.

Sent a man a short dis. up the river to get price of a Canoe there - would not sell - would rent for 1$000 per day. Not a large canoe.

Authorized Mr. Darby, who wished to "geologize" ascend the river, to hire the Canoe, and the man, if he can get him, temporarily.

To day, Mr Wesser and myself went in a Canoe with our friend de Souza, and one of our men, who did the working (sculling, Chiefly,) under the direction of de Souza; The Channel is first on this side, & then trends across toward the Bahia side, as roughly sketched on Page 41.

The water is about 2½ Palms say 21 inches above the bottom Low water of 1878 - Even with this trifling Low depth in the river above the Cachoeiras I found the Paula Affonso canoe Ascended & through pretty slowly.

The current is between 5 and 6 miles an hour through a Channel more than 50 Metres wide and not hard, Curved.

At this time, which is certainly a low Stage of the river, the Paula Affonso Could run up easily.

Mant. de Souza says that the Cax.a da Itacurtiara is Less difficult than this one, though of the same general Character.

Also ascended the main Cachoeira Compo and 4½ Metres in the Channel, and about 2 feet of water over the Large bar, nearest to the Bahia side. Below water comes out in bars. There is another bar below, on the Pernambuco side. The Channel passes between these two bars. We turned our Canoe back on the Bahia side - Stripped and walked up to the [illegible] high bottom. The highest of the [illegible] was 1877 - 78 water mark for above and floods behind & the [illegible] here in the floods, and the [illegible] than ours. Good [illegible]

Rough observations



Mem. Sept. 1st Atalho- Cont.d

Memo- from Halfeld's Map- from Jatobá to Cax.a da Cachoeira do Pourdão (Araticum-a Bahia side- 182.a da Pedra or Pern.co Side) Sheet No 25- and part of 26- League 315 ½ at Jatobá.

1.er Cax.a da Vargem Redonda- L. 314. at lower end of the rapids. Our examinations show that this rapids offers no serious obstruction to ascending steamers or barges, or canoes in Low water. Mr. Wesser and I went through it to day. How it may be in high water, as yet I can only infer, that the [illegible] arm of ragged, black polished rocks, over which the main mass, then rages, will make very rough water; though [illegible] leaving smooth enough water through the Channel for Steamers; and probably good enough for descending floating barges and Canoes, unnavigated.

Above this rapids good navigation to L. 310

Opp. Ao pé da Serra- with current at several points as follows: per hour- 2.05, 2.57, 2.46, 2.67, 2.25, near 310 L. opp. Acpe da Serra

Cax.a da Itacurtiara at or near L. 309½ 3.04, 2.67. at 309 L. a shoal 0.75

Good navigation from 309 L. up to 307 L. at Papagaio- Serra do Papagaio = 2 L.

Good navigation from 307 L. to 299 L. = 8 L.

Just below 305 L. (Corredeira- Current 2.05.)

Other currents beginning near 307½ L. 2.08, 0.55 0.47, Poco, Poco, Poco, 0.52, 1.62 (Corredeira 2.6), 0.52, 1.34, then Sorababe 299 L.

Cax.s do Vão at League 298 ¾

# Here, between 296½ and 298¾ there are serious difficulties in the river, which will require some days for Reconnoissance

L. 298-¾ Missão de São João Baptista de Carcalho- on the Bahia Side.

Rocha's

Special Study. The Situation.

I am here, with a large party, which was selected and equipped in view of navigating, the steamer, on this river with a steamer, which could carry the party and tow Canoes laden with the baggage.

It is obvious to me that the steamer is not likely to be here in time to be of service to me during the present low water season. If I wait till she can get here she could go but a little way up (supposing the rapids to be navigable for her) before the annual rising of the River; and probably she may not reach here before the rise may have begun.

In the absence of a steamer,

My substitute, of taking large Canoes, and with boards making them into boats and hiring river men to pole, or row, or sail them up, was based upon the information that large Canoes could readily be had: and that it was common for them to come to Redondo of Atalho; that they could easily navigate this part of the River as Upper San Francisco; and I was led to believe that such Canoes would be here very soon after we could get here from Piranhas with pack-trains; and that they were in the habit of using sails here as they do on the Lower river.

This information is erroneous. I am to day quite uncertain whether we can get any large Canoes brought down, or when they can be here; and when here, the Canoe men know nothing about using sails. We might make some use of sails with the aid of a few of our men from below who know how to use sails; but our men with sails, or Canoes, on many places, make

heading against the current. I find already on the Falls of Redondo a stronger current than any shown by M. Halfeld - namely, between 5 and 6 miles an hour. The Steam launch can stem this; but Canoes deeply laden, even with a good wind, may not be able to do it, and they will have to be worked up by steam more or less in the fashion to which the Canoe men along this part of the river are accustomed, namely poling and pulling in the eddies and Cordelling them around the swift water, along its edges.

Two or three men, lightly equipped, might ascend the river at a reasonable rate of speed; but this large party, with 12 hired men as a guard (to labor it is true also when necessary) and 5 other men sent to us from Piranhas, now make our whole party 12+5+12 = 29 men. We have two double canoes of large size, and one double Canoe of small size, with their Crews, (6 men on each of the large ones and 4 on the small one, according to Mr Krieger) we should have 40 men - which, without any baggage, would be at least 3 tons. But on taking off 6 of these, there would still be 34; which would encumber the Canoes; then adding the baggage instruments, and provisions, the Canoes would be so dead laden that their progress would be very slow; and I would anticipate that we should have to put off the men (all except the hands working the double Canoes up) at every rapids - and possibly we might at some of them be obliged to Cognten Cargo.

We should of Course be obliged to encamp for shore, in any case; unless we had large barges; large enough to make sleeping room for 34 persons. I will now consider what kind of examination of the

river could be made under such circumstances:

Soundings could occasionally be taken; but only occasionally, because it would be useless to take soundings when the boat would as they would be under the circumstances mentioned most of the time in the eddies, or scudding along the edges of the channels.

No regular system of soundings could be taken continuously in the channels.

Observations of the shores, bottom bars, trees, bluffs, hills, mountains, &c, could be made by the Engineers on the boats, and Mr Hatfield's map tested and made serviceable.

Cross sections of the river, (which however, would only be needed at considerable intervals along the river) would have to be made with canvas of moderate size; which would have to be taken along with the ordnance canvas, for that special purpose; and which might perhaps be used in making some soundings by running down stream through the channels - poling them up again, in the usual way.

Meanwhile there would be nothing for the 12 men to accept to assist in putting up the tents and in striking them and carrying them on board again - excepting that they might aid in scudding the boats in the swift water places, and perhaps aide in rowing.

This guard seems to be deemed a necessity. At all events, I dare not, (with my ignorance of the ways of the people along this valley, many of whom have been great sufferers, for several years) undertake to dispense with it.

It is useless to refer to how I would have arranged this expedition, had I been informed in time of the circumstances, and the object in view, and allowed to plan it from the beginning.

The problem is, with the engineers, and men, and horses on hand, and with what we are likely to command in a reasonable time, say within a week or ten days, in the way of river craft - what is the best mode of accomplishing the most day during the ensuing two months and two and a half months of up stream movement?

1. The main point is, to ascertain the low water depth of the Channels at the rapids - as many as we can during the short season remaining; the rates of the currents at those places, and to note what can be done to improve them; especially at those deemed most difficult; All other things become secondary.

2. How to do this most expeditiously is the prime question.

3. One plan is to divide the force. Myself and the smaller party to go ahead, rapidly, on land, selecting certain rapids for any special personal examination - those deemed to be the most difficult. The other force to work their way up the river, examining as rapidly as they can advance with the boats, the other rapids - also taking such notes as they can of those I may have examined; but not stopping for such purpose

4. Another plan is for about half the party to proceed by Land, the other half by water — to accompany the boats and all provisions together every night — Each party making such examinations as the case.

5. There is however, another element in the problem. It may be important that as soon as possible we should know whether at any rapids within twenty or thirty leagues, the water is too low to permit the ascent of the steam-launch. This I infer from what Francisco de Souza says, and from the number of channels shown on M. Wahlde's map that possibly such a place may exist at the Cachoeira do Vaz, of the 29th League, or 16 Leagues by the river above here — but not more than 12 Leagues by the direct road.

I therefore propose to decide to proceed hither at once in person, accompanied by Senhor José Manoel de Souza, and Snr. Sabbia (Mr. Denyard) to look at that particular Cachoeira sufficiently to ascertain the certainty (either way) or the doubt — as the case may be; & that I can communicate the result to Mr. Krueger, with such suggestions as I may feel warranted to offer in connection with the Launch Paulo Affonso.

The Carpinteiro — who is also a foot-hand will accompany us, and one man with a pack mule — We have arranged to start at 9 A.M. tomorrow — to be gone 3 days — though it may be 4 —

Meanwhile Mr. Wesley will remain in Command at Atalho and attend to all matters. Bon route.

End of Monday — Sept 1.

Same Remarks — General.

The Government to be pressed for the Naval Estimates, should Lt. Lyons [illegible] the Amount Commercial Work of the Boats, and the amount of Hydrographic Work, & the Completion of Charts, &c. &c. &c. Commerce & Navigation Chapter.

Tuesday - Sept. 2. 1 Quarter 4 bells PM
Bound for Cascella Vão.

Started this morning with Snr. Salvia, Derby and our friend Snr. Manoel de Souza, with Caipintans for Cascella, and one Coach animal to visit the Cachoeira Vão - about 15 to 16 leagues above here, by the river, but said to be not over 12 by the road - to be absent 3 or 4 days. The morning is cool & cloudy -

185 Bars

8.20 Start on horse back
10. Road - mud.
10.54 Streams 160 metres abo Hom - 325
Alta Grande
11.20. 253 = out of Can
11.52 225 Fresh float - cloudy
12.03. Turn off to right (1/3 a Nag mile) to a House to get a drink of water - John Pereira & long cattle dam - vegetables, Sammy inside where there had been water - still dampness. Wood cock all around here, and along the main road. The soil is Clay. Sandy -

All East this region rounds in Washes
A small pool of water is still left - for men and animals - When it all dries they dig a Cacimba of mobu, and get water. It is a natural low swale. A slight claim or Sammy bottom.
In rainy weather a large area is filled 40 feet deep. There is also a well - when they get down well made 60 ft deep

John Pereira. Cacimba.
Snr. Pereira says there are a number of dams like this along this region -
Man is much better than before reaching Jabota, but still - what is a man entitled to, fortunately
1.25 295 B. on right of River - going down 5 per cent.
1.40 Pict and Rocks - 1/2 m. from River
1.48 Grande Hook Rock 1/2 m. from River
Sand etc
P.M.
2.00 - at House. Cascella - near the River. Opp. end of Papagaio. Mountain - a



PAPAGAIO

Mass of Scraggy, Cavey, picturesque - fantastic, Union Pac. R.R. looking, Red Sand Stone rock - In rideing down toward Cascella - we Pass one Castle looking rock with a natural window in one side, and near by on the right another in Pelimgue or Bahia Red Sand Stone rock.



Cascella opp. [illegible]

At 2. P.M. - we halt, at Papagaio Mountain calling it 4 leagues from Alatico.
I think it is rather less than more.
We had a fine view of the range for a league or more below us at Scraps around, broad, and with a Cum of Cargo radius, We hid in by the point on the Bahia side. By the river the dis. is called (and very definitely) about eight leagues - Widefield Calls it 7 leagues (about).
Sabuca - about here, where we want to stop tonight, Manoel de Souza calls 3 leagues. He says it is on the river - Sand road along the river from here to it.
Snr. Amarante was here last night - left at 6 this morning - He "arranging", or Apiche about 2 Canoes - one a Lenção, the other two leagues above here - Manoel Victorino, the proprietor here (with the usual attendance of Children of various kinds) says. They are only 30 Palms long - only about 20 feet. [Small Canoes.]
We feed our animals here with Cotton, and Conclude to Cook our dinner and coffee here, and rest for 3 leagues afterwards. A clean road after before us for as I can see for the bend
The Red Sand stone Rocks here have a peculiar defect. Manoel de Souza says that Tigers formerly inhabited some of the Caves. He also says that a few years ago a high pinnacle of the rock, owing the action of the rain fell, with a great Crash like an earthquake.
The most picturesque view of the ending of these rocks range cannot be seen from the river; from the aspect of the river first in my impression. Extensive

Tuesday - Sept. 2, Continued. Papagayo, Guanacaste

after stopping about 2 hours, and feeding our horses, and ourselves at the house? Built in the usual Style of the Country, with a very strong up river wind (as our former we remarked and stated for Sabuca at

5 P.M. The river along here is one half a mile wide, and the Bahia side reminds me of views along the Delaware, below Bristol. It is a clear river for a League or more above here to the long cocoa-nut trees on the Bahia side. The point about 1½ miles above on the Bahia side divides the currents of the river on that side.

Arrive at Cuacata (about a League below Sabuca) on account of Capein for horses -

Large house - women, mother, daughter & wife (Col Indian) of the Comp - bed & Br. Fabrics Hammocks Sleep in one end of the usual house, made thick - Cocoa-nut plenty - Wide handsome river - all along here alluvial soil - gently sloping away from the river needs only water to make fertile land. Houses? along the river banks are not over ½ mile apart

## Wednesday - Sept. 3d

a.m. from Cuacata -

Start - 5.05 Same alluvial Slopes.

6h. 10' Roads fork - One goes along up river - the other cuts across - we cut across

7h. 10' Barranca 230. feet

Soil, the angles to granitic - surface covered with numerous stones.

7h. 45' Cross PATAU river - a large deep bed 500 ft between banks. After passing this, we make many of the fine creeks, bottom. I see water in the river ½ mile below. alluvial

8.30 river. It is only a few miles from the S. Francisco coast. The river, home at the House

We now go again along the Costmary Sloping river bank or high bottom - clayey alluvium.

8.45 We stop at Jacuriba (Cahuas) and arrange to feed the animals. They make Salt here out of the clay - about 2 cups out of 2 qts & bucket of earth.

These Names, that seem like names of Towns - merely designate a Ranch, or place along the rivers. One house in much like another - one family like another - only here we see the better side of Civilized savages.

SALT is made along here out of the Earth, which seems to be

a Pig 5 or 6 months old.



Wednesday - Sept. 3 - Cont'd

Yesterday and to day - after crossing the river, we find the soil quite different from the hard gravelly and sandy soil below Cuacata. It is a clayey alluvium, which needs only water to bring forth fertile.

The river itself which contains a tremendous of water affords power enough in its flow to free up water upon nearly any plantation. The winds which blow strongly two thirds of the 24 hours give a power that would do the same thing. These Lands at the river are generally a little higher than the highest floods - they thence descend very gradually for about half a mile back to where the Land is inundated every year. With rain, more evenly distributed, these High bottoms would make grand farms without irrigation.

I have been to day a little above the 29th Degree - or 16 Leagues above Nicoya.

With Island on the side -

There are two small creeks on the opposite side of the S. Antonio Island - One 70 or 80 ft wide, 15 ft deep, about 4 ft deep over 4 ft wide, above - 100 yds. below (bed & sides solid rock) where we have at least 6 ft now and which with some help the boats could go up.

The water falls here to about 3 ft depth. Then the Land could not go over.

From ascending boats, there is deep water on the Bahia side; but for descending boats a Channel Course thro' to Nicoya has a side of S. Antonio Island.

At the Corner point of the island the Channel is confined to about 20 feet width - where there 3 rocks one about under after breaking it - Navigation & good Channel more for the Paulo Affonso. It will cheap work to Concentrate them there will refuse - the work with a single good Charge 4 or 5 ft deep in hard water - At present there is over 4 ft

Wed. Sept. 3. Cont? Cachoeira do Vão.

Tack at 12.25 – down river – at 12.50 – pass two rapids between us and the little island which may be seen. The Channel is on the island side of this arm are 400 ft wide – The two rapids about 400 or 500 ft apart – a dam 300 long 10 ft wide, with a clearing 100 wide in the Channel at the upper fall 8 ft fall about 200 – other Channel of the two is dam 200 ft wide do the same. This is the highest Cachoeira I have seen on the river; but there is another terrible about – I think that with dam will the Paulo afforo could go up now but in Januar low water it is doubtful whether they Could get the water above the Cachoeira.

The Channel on this side is the hardest looking Channel I have seen; but I think that now there is a Channel about 10 ft wide with a fall of 1½ ft in 100 – and probably a deep one 4½ ft – as I think with the aid of the men the Launch could be put thro' but with the water 12 to 18 inches lower it is doubtful whether it – 2 ft fall is

Below in another rapid. Tack 11 to 20 ft wide and good depth.

(Cachoeira) do Vão.

2.00 P.M. Accord from here

3 Reps – The Lower one of the 3 we are in doubt about* these with reps are very favorable for Channel

2.30 – We stop at Sen Domingos Ant° de Regueira friend of José Manoel de Souza – who is with us.

We Land first Mr Amarante himself on Canoe pass me with oars the river 94 Palms long, and that is the Channel – Cachoeira timarino.

Wed. Sept. 3. Cont? Cachoeira do Vão. (67)

I Conclude to go across this arm of the River to the foot of Sobrabobe island – which is just above this Fazenda – and walk up & Meet them from the Cachoeira do Vão.

M. Amarante, Dutra de Souza and I – were taken over by the young man – We walked up on this Island & inspected The elevation of which is near that of the highest floods – it is not all over flown, and most of it only to a slight depth. It is a splendid place for Fazendas, irrigating, farming.

There is here abundance of water power to turn up all that would be needed for Supplying a magnificent farm.

We cross over in a canoe from Sr. Resende's magnificent Caraibeira tree, on the River Bank to the p.t of the Island. We start at 3.20 and arrive at the Falls of Vão 3.55 – with but little pause.

We stopped ½ mile above Point of Island to look at Large gravel bar, which appears to be the Channel on this side – which is Regularly, the Channel on Right side – which at present is deep enough for the Launch – but is not deep enough in low water.

3.53 – At the Falls of Vão A regular Cascade – Rapids – about 400 to 600 ft in length. The Island angle of the river from the island ends of the rapids is about S 70. E (about) The water is very [illegible] an inch 20 inches above low water.

Mr Hastings, the Paulo Affonso Guide was from this Falls afloat. There are many Little Channels, but only one new fit for Canoes & boats. We Cross on the Island side, about 8 feet wide – with a depth of 2 ft to 20 ft (and 1½ in 10 ft) and the Launch could Certainly obtain – We could nearly Cross this Little Channel, and the water was a little and flow over the rocks on each side of her. In low water We could be made across. The Launch not reach the Falls.

The young man who came with us says that this arm of the river can be found, in October — Confirmed by our friend Manoel de Souza —

There is now a large body of water flowing in a direct line across the mouth of this arm of the river; but it is divided only by a sand bar not perhaps 20 Cattle wadeth channels or falls — Within 50 ft of the Channel referred to and a Canoe cannot safely pass there —

If this arm of the river — should be the one selected for improvement, the plan of the Falls or reef, will be to build low ones below the upper ones entirely across the reef leaving only one place say 50 ft wide which should receive all the water in low Stage, and also to blast out some rocks — perhaps a hundred or two hundred C y ds when this 50 ft channel should be made — and only so as to make guides for the Channel

There are two places — one near the middle and one near the island, to be cleared at first — At the same time the bars below and the rocks above must be improved, or this work here could be much thrown away —

Every thing being prepared before hand the work should be done in Aug.t Sept. and Oct.r — a moderate force of American Hands would do it all in that time or less.

I see plainly however, that more time is required than I was inclined to assume when I examined the upper reefs this morning —

The Bahia side of the river must be carefully examined before any thing more be done.

The Canoe Point is now settled I must state that the Canoe cannot pass this point until the rise in November —



300 ft. below the Falls, is a reef just now showing a little out of water — that could soon be treated in the same general manner; but it has not over 6 to 8 inches fall Reef nearly at right angles with the River, Length (a crooked one) parallel line with the Falls —

A 4 feet depth at Machicolas to be had on that Arm at a cost, which I can approximate after Examination. It must be Compared with the Bahia side.

4h 45' P.M. —

Our walk back on the island a straight course occupied just 30 minutes, and we dabbed more than 3 miles an hour; as that the distance by Barao's arm is 1 1/2 miles. from the Cachoeira do Veo to the lower point of Island Sorobabe

We have arranged to feed our animals and eat our dinner here, and remain over night in the house of Domingos Ant.o de Rezende.

Walked 5 miles to day.

After bathing myself, I felt as if I could walk the Cachoeira Falls a dozen up the river! Barao's Arm on the Pernambuco side, I resolved to examine the Bahia side — which is the Main stream, where much the larger body of water passes, which once possibly obtain as far as one day longer away from Abaiba.

The plan is to take the large Canoe, which Mr Amaranto had arranged to start to day for Abaiba, and paste it up to the Falls on the Bahia side. That is from a contract made for the Launch (when she has been repaired) I am to accompany (go in) the Canoe with Mr Sabrosa, and our baggage down the river, while Mr Busby and Manoel de Souza, go on horse back, about the mountains. and our Soldiers will take the horses back to Abaiba. A Good days work!

Sorobabe.

Thursday Sept 4, Sorocaba
Permambuco

Sept 4th Cont

Cachoeira de Ytú

Bahia-Side Channel

Below the Commerce of Itú are falls, the Ribeirão Sorocaba

Below the Commerce of Itú are falls, the Ribeirão Sorocaba

Above the falls I have been in the habit of hiring canoes, but this time I was requested to hire a canoe from the Commerce of Itú

Above the falls I have been in the habit of hiring canoes, but this time I was requested to hire a canoe from the Commerce of Itú

Near the head of navigation on the Sorocaba is a fine Commercial town called Itú. Here I was met by Mr. Cesario Motta, a gentleman who had been educated in the United States, and who had married a beautiful American lady. Mr. Motta had also been in the Paraguayan war, and was a Major in the Brazilian army. He had been wounded in the battle of Tuyuti, and had returned to Itú on account of his wounds. He had also been a member of the Provincial Assembly of São Paulo. He is an intelligent, enterprising man, and one of the most influential citizens of Itú.

Army examinations at Rio. Relics of the war. Visit of the Commander-in-chief. Cachoeira Falls. Mr. Motta's family. Beautiful American lady. Visit to the Commander-in-chief. Mr. Motta's family. Beautiful American lady.

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(72) Letter to Dr. Luiz Plinio d'Oliveira

This letter is changed on page 79.

Dont expurgate.

Finding that several days must elapse before we could receive our bonds from Pirambóia, for arrangements our Agents to carry us up stream, I took the Cabrita, and (Mr Darby volunteering,) and, under the guidance of our friend, Manoel de Souza, started on tuesday, Sept 27, to come back to the Cachoeira do Vão, in order to decide, from personal examination, whether the Canoes Paulo Affonso could pass up through it this season, when the annual rising of the river; and also to study the rapids, which Engenheiros Halfeld, and Bramco, pronounce the most difficult on the river above the Cachoeira Paranaiba.

The Cachoeira do Vão - the main fall, is about 15 leagues by the river above Itacho; but we omit a League and a half in going and coming by the cutting off the bend. The upper rapids on the Pernambuco side, and then examined each fall or rapid, down to the lower one of the Volcano, Sete Voltas, (at the Fazenda of Snr Domingos Antt de Rezende, who made us welcome and comfortable house, at the beautiful tree Caraibeira, one of the Handsomest trees I ever saw, and the finest shade tree we have seen.)

After examining the several Cachoeiras on the Pernambuco arm of the river, finally, along the main shore and finally on the island Sarababa - which we reached in a Canoe; we got another Larger Canoe, and pushed up on the Bahia side as near to the lower falls as it could go, and then walked over the rough block rocks to the lower falls. There are two about 200 meters apart.

The Cachoeira Paulo Affonso Canoes pass up at this time, on either side, and the water has yet to fall at least two Palms, to two and half palms. The Cabrita was taken past these falls, which are more than a League in length, till the river shall rise, which will not be here before November, and not in time to be of any service to us during our present season of examinations.

I must report to Chief Eng. Kreiger. He will act according to the orders from the

(73) Government of the General Government decides to [illegible] from the Cascade transportation are [illegible] independently of any service that steam will [illegible] Companies may [illegible] by Steamboat Companies, but if the Government expects [illegible] something, but if the Government expects [illegible] able to avail [illegible] of its aid in ascending the river. I must state that it [illegible] is not practicable.

I am not yet prepared to make any definite suggestions in regard to the kind of steamers to be used on this upper San Francisco [illegible] Lower end. I am inclined to think, from what I have already seen, that the American model of light draught Stern Wheel steamboats, [illegible] would be found most advantageous. Such a steamboat can carry 120 tons of freight without drawing more than 3 feet of water - a boat about 100 feet long from Stem to Stern, and 20 feet beam; which ought not to cost on the Ohio river more than $15.000 complete. These boats could be framed, taken apart, sent in pieces which should not weigh more than ten, or at most 3 tons for the Larger parts, delivered by a vessel at Pirambóia ready to be shipped, and taken over the Paulo Affonso Railway as soon as it can be opened (or even hauled over the Cascades).

Such a boat could [illegible] Larger than carrying 100 tons, up the improved San Francisco, when a depth of 4 ft. in the river at low water; which with the Large volume of water in the river can probably be secured during the driest part of the driest season. Possibly, at the swiftest rapids, she might have to make two trips through the rapids if she had five loaded barges in two [illegible] up.

I believe that such a steamboat could be put together complete or [illegible] at a total cost of $25 000. in less than one year after giving the order.

The Paulo Affonso has a Channel not at all well adapted to the Upper S. Francisco.

Thursday Sept 4 – Cont – from Page 71 – in the River

We went on to show on the plan about ¼ mile above our house – to pass at 10.57 at 11.05 in area of 1¾ Mile in 41 minutes.

Sorobabe.

We then breakfasted – discussed the pros and Cons of going down river with the Canoe, and decided not to go. Ordered the horses to be made ready for a start. but Mr Da Cruz and Manoel de Souza will make their trip down river "Pogo ou Cabo" (Meaning well finished)

Senr Dom.s Antº de Rezendes.

1. P.M. Start from Sorobabe for Cumiata

2 miles at we stop 15 minutes to pass animal

2.05 Cross the dry beds of Pagaé River – farther down than where we cross it generally. 2 Plantations here Worthless on the bed of the river – Cassava, Corn, Sweet potatoes, melons, &c – Miserable growth owing to the region

4.05 Sabuica. Stop and get a good Drink of river water. Here we have crossed the big bend and are on the river bank again –

4.35 For Several miles we have a good Road the Alluvium – Alluvial, high bottoms,

4.35 Cross the dry bed of a smaller river – Bed filled with the same is ahead down –

5.05 Stopped at house on River bank where Senr Cesar and had made some arrangement about 2 Canoes. We went to the river and saw the Canoes. It is a fair modern Canoe, for this river – 27 ft long x 39 Palms long – about 2 ft wide –

5.35 – About a mile or so below the Canoe we Stop for the night, at Cumiata – the same place we stopped at on the night of the 2nd inst. on our way up. Compared with some indians met on our Travels above here, these people are quite Civilized.

We can see the Sapucaia Mountain from here away distinctly bearing S.35 E. – we with Officers Crew of the river to day having to go round a large bend in the river before we to the north. It first bends here causing gently to the left – then away about EAST for [illegible] and then curves back to the north on a long reach



Friday Sept. 5th Cumiata to Caxumba to Breakfast – Mr Derby and Manoel de Souza – Start for Pogo ou Cabo about 3.30 a.m. after our usual Coffee.

4 M.

5.45 Start for Cumiata – Cool but not Cold – Cloudy – which tempts us rain – not heavy – Ventilates us.

6.20 Dry, small river

7.20 Cassella – We pass without Stopping – Some outdoors here, with Convicts going to Pernambuco & Pernambuco.

7.35 Castle hills visible – The Sapucaia visible Virgin Caves in the Main Mountain Ridge

7.45 The Summit of Sapucaia Mt. Peak Sandstone

Heavy Sandy road – Mahoo heavy as ascending from Cassella – Continues, with Occasional intermission.

7.55 Passed Summit, About 2 Leagues from Sorobabe –

Heavy Sandy road – Mahoo heavy as ascending from Cassella – Continues, with Occasional intermission.

8.50 We strike the road leading into Caxumba (a place with Dry reservoir. visited in Winds on our first day out from Atalho.

8.57 We reach the house, and alight at the invitation of Senhor

9.08 Our Pack-train (Consisting of one Cattle gray horse) arrived in Charge of Manoel – the Carpenters & Cook for this voyage. Here we are to breakfast and rest. The rain has ceased, and the friendly Clouds hide off the heat of the Sun. It is very pleasant here.

Goats abundant at every house

You have great mention of it I will now mention, that during our trip we daily 11 days, in every house, saw the inhabitants there were me, but generally two boys from 2 to 3 years old always perfectly naked – night and day – all have large bellies – and short legs Compared with the length of body – And all are dirty all over.

Washing seems to be relegated to some [illegible] day,

Mr Derby

has just walked a away for our use, at the invitation of Senr. Sabora. The Sapucaia is about a quart and a pint. There are quite a number of Cows 14 miles Cows and the Cattle

26 Friday Sept. 5th Carvimba

A queer form of engineering

About 200 ft in length at one end is about 5 ft higher than the remainder of the embankment and the water would flow out over the natural surface at Si before it would rise to cover the top of the lower part of the embankment. The upper 5 ft of the high part (or rather 5 ft of it broad) is constructed of stone - for the two ends at A and B and a S. is as low as at S. Just Way Called a Considerable body of Clean water.

At present the small hole wherein the pipe is set is about 15 ft below the bottom of the valley. They follow down as the drought goes on - They say that they have never been without water for the animals.

The Reservoir - seems to be all that renders this place habitable at present - and all the farming that is visible is in the bottom of it, after the water has evaporated (and perhaps some of it seeped away) and become soft to them.

The main dependence is the Cattle Gathering and the reservoir for water.

Farming, as we understand it, is not here, nor any where else that I have yet seen.

When the Dew Stones out Clear of Clouds the evaporation is very great.

Finish Breakfast at 11 A.M. a very good one.

Just here I am writing the very image of the Egyptian a Gypsey girl (in Wax) that was in the window in Chestnut St. Philadelphia - following the figure of the tattooed woman - eyes, hair, complexion, figure, dress are the same, but, what if they were dressed and handsomely dressed would be Comely, brunettes, notwithstanding their olive complexions.

Industry

Our son-in-Law here is a Shoemaker - a good pair of slippers Kid-Skin shoes 1$000 - an elegant Carved large gear chain 1$000 - They don't seem to value their time at any thing.

Friday Sept. 5 - Continued - Carvimba 27

Fazenda Pereira de Barros

We left Carvimba - at 12h. 33m. arrived at the summit of the range, along the Rear, sandy road over grading ranging from 1 to 3½ per cent - Curves, regular surface Easy and long straights - a Charming road for a rail road - on both sides of them - I call it 9 leagues and a half to the Remonte from Pereiras Farm - Thence to where the side road for Manoel da Souza takes off is 1 league - Thence to his House he calls it 1 league - I make it 3 leagues from Pereiras to da Souzas - We arrived at Souzas at 2.05 - Thence to Pereiras Farm 1 league - Thence to ENCAMPMENT at 3.30 P.M.

at 2.00 P.M.

Ofenia Senr Cavalcante here with Letter from Mr Kruger, Mr Lenhares & Mr Lobato - Proffering the services of Cavalcante to aid us up the river.

We dine - at 4 P.M.

After dinner I proceed to answer the Letters - and I hand them around in English to Senr Leibon to be put into Portuguese at 6 P.M.

The news is that the wagon with the boards and other things arrived at Olho d'Agua - 3 leagues out from Pirambara only, on the 3rd inst, having not started till the 1st instant from Pirambara.

(COPY) Alto Sept. 5, Evening

Senr. Gumercindo da Silveira Lobato (Engineer) Chefe de Secção, Pernambuco & Parahyba Railway

I am obliged by the receipt of your letter dated Sept. 4 inst. City Hall to me just now on my return from the Cachoeira de Cão, and I thank you for your kind offer of the services of Snr Cavalcante. I have no doubt that it would be agreeable for us to have Snr Cavalcante with our party, but I do not think it is necessary; he has given me letters to his friends up the river, for which I feel under obligations, and I will not fail to deliver them if I can meet the gentlemen. Thanking Snr. Cavalcante and yourself I remain etc etc M.R. Engineer in charge

78 "Commissão Hyd.ª" Atalho Sept 5, 1879.

Reinaldo von Krüger
Engº em Chefe &c.

I have recd by the hands of Sr. Cavalcante, your kind letter of the 3d of September, for which please accept my thanks.

I have just ret.d from a personal examination of the Cachoeira do Vão, which I made partly in order to ascertain to a certainty, whether the steam-launch Paulo Affonso could pass up the river through that Cachoeira at that place. I carefully examined a league in length on both sides of the river, including the chief difficulties, and I have to report that it is not practicable to put the launch through or past that place until the annual rise of the river in November. The water is now gradually falling. It is still two palms, or perhaps two and a half palmos above extreme low water, so that it is daily getting worse.

I wish to telegraph to Sr. Plinio as follows.

Atalho, Sept 5.

"I have personally examined Cachoeira do Vão, and respectfully report that the launch cannot pass there until the annual rise of the river in November. She cannot aid us in ascending the rivr this season."

Please have the above telegram with my name attached sent by the first opportunity.

I thank you for your kind offer to allow Sr. Cavalcante to go with our Commission &c. I am already under obligations to Sr. Cavalcante for letters & friendly offices up the river, and I do not think it will be necessary for him to go. The delay of the launch and part of our instruments is unfortunate but I know that you have done all in your power, upon my short notice, to facilitate the movement of the Commission.

I see you blame that the ceremony of the Ceremony and the river at present [illegible]

Telegram to Commendador Dr. Luiz Plinio d'Oliveira, Secretario &c.

Atalho Sept. 5, 1879

Telegram

I have carefully examined Cachoeira do Vão, and respectfully report that the launch cannot pass there until the annual rise of the rivr in November. She cannot aid us in ascending the river this season."

Letter. Atalho Sept. 5. 1879

Commendador Dr. Luiz Plinio d'Oliveira - Secretario, &c,

I send at this date the above telegram to Chief Engr. Kruger at Piranhas requesting him to have it forwarded by the first opportunity. Present in portuguese.

I returned this evening from a few days homebuch journey to the Cachoeiras do Vao - and the other Cachoeiras in that vicinity, which I examined during most of two days on foot and in Canoas* & I am fully satisfied that it is entirely impracticable to pass the launch, in any way, up those falls and rapids until the rise of the rivr in November.

The water is still 2 to 2½ palmos above extreme low water, and gradually falling, so that it is daily becoming worse for a boat of the build of the Paulo Affonso. She is not well adapted to navigate the Upper San Francisco. (With the river improved, the most advantageous steamboat will be something after the model of the Ohio river, or Upper Columbia river light draught, stern-wheel steamboats; suited to towing barges, and also carrying some freight herself. In due time I can give you particulars about these boats.)

* I was accompanied by Senr Salvia & Derby and our friend who has been Senr José Manl de Souza -

FALTA A PAGINA 42

Continuation of Letter Commenced from Novo
On the 3d inst. the wagon with the Cowans
Arrive which brings us to Santa Cruz de
Laguna, where we have to stay
over the Steamer of the Company
are expected, when we shall
proceed direct to Orotava
Puerto Orotava Canary Islands
Sept. 6th 1879

Letter.

Sept 6th 1879

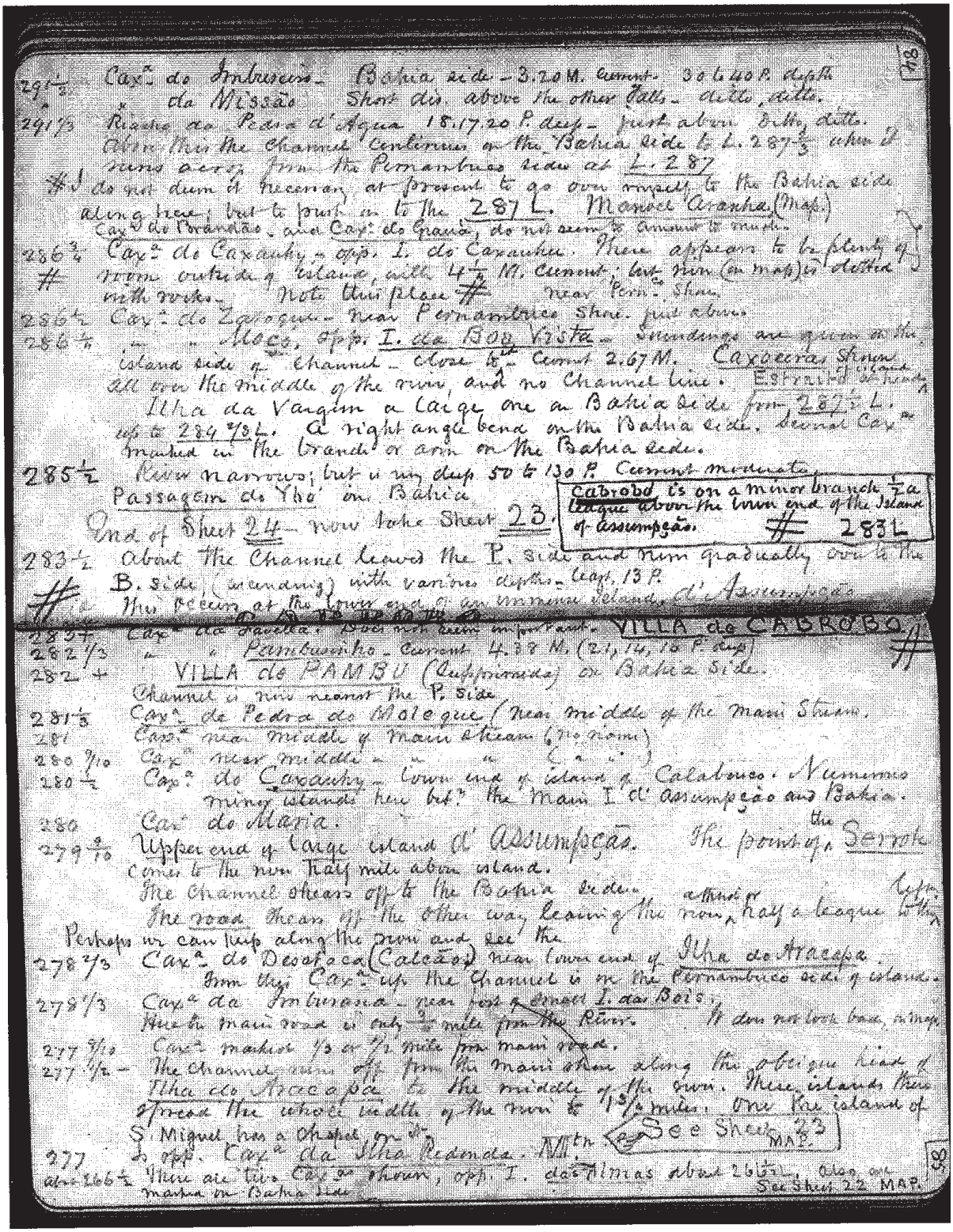
Orotava

On the memorandum of Contract between
Messrs Cowan, Together with me to C.C.
Same evening me & my wife.

Mr. Cowan to join Cowan expect
here on the morning of the 6th / and in
the evening of the 7th of the same
also, Mr Cowan, Mr Robertson to get
2 men Brindle Cowan to Cruz Santos
Fee.

Green Cowan with the 2 Cowan
Wilson Mr. Cowan to have engaged.

Sept 6th 1879



Leagues. (Sheet 22) 62

276. Opp. end of Serra Das Caraibas Nº. Do OROCO

Caxª do Beiro – near here.

From Nº. Nº. about 276 L. Channel runs on among many islands toward the Bahia shore – along which there is continuous for several leagues, with various depths and a Mean Ascending of 8 P. some as deep as 70 P.

273½ Caxª do Castagallo – Malhada dos Cachorros

These numerous small islands are surrounded by 3 Considerable ones – "da Caxª" near the P. shore I. da Villa de Santa Maria near Bahia side, and I. Grande between them and about the two. See Sheet 22

275+ Caxª da Vilha Near the Bahia side.

274½ Fagundas – Opp. this, the road has shoaled off ½ mile from the river, where it takes off, and Crosses the Serrote das Cobras

Mata The cluster of houses on the P. side, Caraibas, is about 274 1/4 L. Opp.

I follows the road that takes off from the river about 274½ L. & runs

2 leagues away from the river – Coming to it again at 270 L. Map

There is a rope following the run it is about a league longer than the road. See

Reached Boa Vista Oct. 7, 1879

Villa da Boa Vista – At 268⅝ L. This puts Boa Vista

About 730 miles (43⅓ Leagues) above here, Ataliba.

Allowing that I travelled along the road 3 leagues per day, including examinations, it would take me 14 days – Say 2 weeks to reach Boa Vista. 314 / 246½ / 67½

246½ L. Now look up Joazeiro –

Joazeiro – Villa do Joazeiro, in Bahia. 22+ Leagues above Boa Vista.

From Boa Vista to Joazeiro – 22 Leagues – I consider 3 days, or more back or perhaps in a boat or barge in the same time – though no road is shown, above Boa Vista

239 L. From Joazeiro up to Cachoeira do Sobradinho, is most of the distance plain sailing on the river – or should be, according to the Map. about L. 239 – only 7½ Leagues above Joazeiro. Say 2 days more, on the river. In all 19 days, and allowing Stop 1 day in Boa Vista and 1 day in Joazeiro – 21 days = 3 weeks.

SOBRADINHO. 239 L.

That is, about 20 days on the 9th Sept would be at Sobradinho Rapids – with my preliminary notes in my book – by the 1st Octob. ready in two or three days to return – or to keep up the river, as may seem most advisable. * This was not the case – We did not reach Ataliba till the 15 Sept. and we reached BOA VISTA Oct. 8th

Villa do Xiqueyique. on the right bank of the Ypoeira about ⅓ league above its mouth, at the head of the very large Ilha do Meradouro – and about Opp. 179 L. or 60 Leagues above Sobradinho Falls =

179 L. Bahia side

Xiqueyique is not on the Rio S. Francisco but it is Connected with it by a navigable Channel for barges and large Canoes about a league in length. It has also another outlet by a navigable branch along the Ilha do Meradouro, which joins the S. Francisco about 2½ to 3 Leagues below the head of the Island. The Canal between the Villa do Xiqueyique and the main river is Called Ilha do Gadotraba. I presume therefore that there is another Connection between the Ypoeira and the S. Francisco, not shown on the Map.

167½ L. VILLA DA BARRA DO RIO GRANDE. on left bank of Rio Grande at its mouth.

OPP. the I. das Laranjeiras.

RIO GRANDE. 167½ Leagues in [179 less 167½] 11½ leagues above Xr.ª Encr.ª

126.6 L. Villa do Urubu – on the right bank of the right hand channel of the Ilha do Urubú – the main town stands a half mile from the river. Ipanema owing to the ground being subject to an[illegible] in front.

110.80 L. Sur Bom Jesus da Lapa – on the right bank of the river, on a sort of arm, or bay – (Capella na Pedra Calcárea – Ypoera.) Fazenda, same name on left bank of river – All in Bahia.

87. L. Villa da Carunhanha. On left bank of river – Opp. island of same name – nearly one league below the Rio Carunhanha – which forms the boundary between BAHIA and MINAS

Bahia
Minas There is another town on the right bank, about 2 miles above Carunhanha – nearly opp. the mouth of the tributary – called N.ª S.ª do Rozario da Malhada.

80.4 L. The Rio Verde Grande – enters, on the right bank – It forms the boundary between BAHIA and MINAS.

The river above this point is entirely within the Provincia of Minas.

74½ L. N.ª S.ª da Conceição de Morrinhos

Pedra Calcarea of Limeira

67 L. Jacare – a village on the left bank – in Minas

56.6 L. Lt Bank Porto do Brejo do Salgado. [Villa da Januaria stands about a league off on same side – the left bank of the river

53¾ L. N.ª S.ª da Conceição das Pedras de Maria da Cruz – on the right bank.

24⅔ L. Mouth of Rio Paracatú – in Minas a large tributary – Soundings shown 2 leagues up.

5 L. about – Mouth of RIO DAS VELHAS, or Junction of the two rivers. A large bar in the Rio das Velhas at its mouth. Above, on the Map, the S. Francisco appears the larger – but no soundings are given – except for about a mile above the mouth.
Nor are soundings given in the Rio Das Velhas above.

0 Pirapóra – Cachoeira da Pirapóra

The Rio das Velhas is marked 7 leagues up to Roça do Capt.m Hippolyto. See next page

These memorandums made from Hatfield's report preparatory to arranging a new programme to suit the circumstances – The Commissão Hydraulica being at present in an awkward situation, and doing scarcely any thing yet.

M. Halfeld's measurements of the das Velhas and S. Francisco, giving the flow:—

For Second

For the Das Velhas, 9.159 Cubic palmes per second = 7.43 Palmes in de
549,540 C.P. in Minute 3.09 Vel. per second
92.2 per Sec

For the S. Francisco, 22,493 1,349,580 C.P. per minute 1805 Palmes in de
276,8 per Sec exclusive 1.65 mod. in 1000 P 3.14 P. per second Vel.
99.34 C.P = 1 C. Mahy

Below the Junction
The where R. S. Francisco 31,652 C. palmes per second

[P.S. Mr. Halfeld says (page 54) that the river in front of Pirapora — 6000 palmes = 250,000 Cubic palmes per second — V. 3,465 palmes per second, 1.482 miles an hour — 24 palmes above ordinary level in 1833 — and 32 palmes in 1792.]

4579
9159
18318
4579
22897

Mr. Halfeld estimates cost Pirapora to Sobradinho — $36:352$

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| and m'l'equan | 26 | 30 | 39 | 44 | 49 | 52 | 56 | 61 | 67 | 68 | |
| 69 | 77 | 78 | 79 | 80 | 81 | 96 | 97 | 107 | 108 | 114 | 123 123 |
| 124 | 126 | 136 | 137 | 142 | 102 | 104 | 152 | 159 | 186 | 192 | 196 200 239 205 |

10:400$
20:000$
70:752$

Marginal work
Sobradinho to Joazeiro 416:320
to Boa Vista 53:850
470 170

470:170~
540:924$000

Hydrographic Survey
Engineer in Chief
Rio de Janeiro

Conclusion of letter Engr in Chief on Creek Reinaldo Von Krüger — address at Chalhao Sept 5, 1879 — from page 78.

— me most favorable for making a canal & port — I said however that I should be obliged to them if they would send me a man to measure the river & I am quite sure that Mr. Halfeld would be glad to do it — Mr. Halfeld's name is well known here & I am sure that the Government would be glad to assist him in any way.

I will not take up more of your time now but will write you again from Joazeiro — I am Sir

Very respectfully
Your obt. Servt
W. Milnor Roberts
Engr in Chief

Chalhao Sept 5th 1879.

Illmo Snr.
Manl. de M. Reis
Joazeiro

Dear Sir,

I am just arrived from an examination of the Cachoeira de Casco and have written a report to Mr. Roberts, which I leave with you to forward to him. I will not take up more of your time now but will write you again from Joazeiro — I am Sir

Very respectfully
Your obt. Servt
W. Milnor Roberts
Engr in Chief

## Sunday Sept. 7th Cont'd Atalho.

Continuation of Letter to Chief Engr Kruger

than $400; but I do not like the idea of changing the rate by increasing it, in any case.

Is it true that the rations were changed, as stated? Would you advise me to let them withdraw their families and raise their pay?

I would prefer not to make any change.

We have seen two canoes about 50 palmos long. We are not likely to get any more as large; but we have no means to fix them up.

In case there is much mail for the Com.ao by the Steamer arriving Tuesday, please use your judgement about sending the mail man out once or waiting till the Thursday mail comes.

I remain &c &c

W. M. R. Engr in Ch.

Atalho Sept 7. 1879

My dear Son

Mr. P. Roberts.

x x x. I want you to ascertain (and get an estimate of) the cost of a Steamer in Pittsburgh, so that she can be taken apart (non-condensing) for shipment to the S. F. River via New-Orleans. Steamboat, long about 100 ft (clear of wheel) about 20 ft beam - to draw about 2 ft. light; and 3½ ft. loaded with 100 tons; strong enough to tow 2 barges, each carrying 100 tons, against a six mile current. Acc.n Cabin, say Planing for 50 persons. The pieces generally, for shipment, to weigh less than 2 tons - extreme case (1 or 2 pieces) 3 tons. To be shipped to N. Orleans, there to be put on board of a vessel (not drawing more than 10 or 11 ft.) for the mouth of the S. F. river. Correspond with M. B. Adam & Co. about freight to mouth of S. F. River.

I do not confine you strictly to the above dimensions.

Consult Capt. R. C. Clay;

Do not circulate the information that any such thing has



been ordered. I want merely estimates of the cost of the different movements - Cost & time of getting the boat up on the Upper S. Francisco & Launching her 2 men - to come out; one for the trail to Lassen, etc. Plenty of good teams on the ground.

You can let it be understood as a suggestion of yours - to write to me, suggesting as much as you like. The cost after she reaches mouth of river I can estimate here, if I know how long the 2 men with plenty of help, would take to put her together, and launch her on the S. F. river.

Love to Jodie and the babies, Dear old Father, W. M. R.

## Sunday Sept 7th Continued!

Finished writing about 6½ P. M. and made up mail, directed to W. Kruger - which is to start at 2 a. m. tomorrow morning to be in Prairie Creek tuesday morning.

A very fine day. The wind is not so strong this evening, as usual. Warm in the Sun; but pleasant in the shade to-day.

## Monday - Sept. 8th, Atalho.

A bright beautiful Sunrise a few minutes before 6 o'clock.

Announced that another Canoe has arrived; sent down by Sr. Amarante, who has gone farther up the river after another.

Senhor Amarante returned to day having purchased in all 5 canoes; 2 averaging 500 palmos, (35 ft.) 2 av.g 38 palmos (27 ft.) and 1 of 30 palmos = 21 ft.

A heavy barge, about 4 ft wide & 50 ft long also came from above Ladeu with Rubber, cocoa, sugar, in cakes.

Monday Sept. 8, Continued.

This barge is said to have cost 300$ 000 when new. It is no longer new. It is very heavy and logy, and leaks badly. I doubt whether it would exist an week on this part of the river. I will first see what we make in the way of "a foreiro" out of our Canoes.

We had to send 4 Cagueri to the woods to get timber for an oar and mast. The oars are made, well made by our two Carpenters. They are excellent workmen.

I now think of sending about half of our cargo, or some 90 Arrobas of it on pack animals to Cabrobo to light our boats, unless this barge that is here will agree to take it up in time for us at a lower rate.

The usual Charge from here is 8$000 per pack animal; or 1$333 per Arroba. 6 Arrobas per animal. A little over 2 cents per pound, for say 80 miles, by the road. [about 93 miles by river.]

Our instruments, oars, Cables, etc, Came this morning on the pack animals I have sent after them. They report that the cargo with boats will reach Jatoba tomorrow evening or the next morning.

I re-perused with interest the admirable paper of Thomaz Garcez Paranhos do Montenegro- 1875 A Provincia e Navegação do Rio São Francisco.



Going up stream-

Varzea Redonda

296½ Rapids of Itacuhiara - Cancella. [I have been there

299 Cachoeira do Vão! Espinhos!

297 Fura - Olho Rapids Little island - Tacuruby

297+ Urubú - Rapids.

This is all on series from 299 to 296 7/12 2½

Villa of Rodellas! Bahia

296½ do Certum Mina de São Joaõ Bap. de Rodella

296 Boa Velho. Rapids.

295½ I Pinnacle Island.

Pancella de Bassio. (Whirlpool C. Calhau danger!

293 Caxauhy de Cima - Rapids.

292 2/3 Cap.ª de Cantagalla - Rapids

292 Rozario - Rapids - Extensive.

291¼ Umbezeiro - Rapids

290 3/4 - - -

Counting up stream.

283½ Banco d' Areâ - Rapids.

283 Favella - Rapids. 2 channels - clear Curr. on the one on left side.

282⅔ Pambusinho - Rapids - Extensive - great Curr.

282 Pambú - Rapids. -

282. Pambú - village - Capim Grosso 30 Houses.

281½ Moleques - Rapids.

Median village

Chapel. Our Lady of the Assumption

279½ Cachauny de Cima - Rapids Large Id. supposed end of Id. do Assumpção

Portão - Rapids - called very dangerous. pass going down on L. Cabrobo

Island 5 leagues long, Assumpção

Better channel Bahia Side.

Id. of Sacco

Mocós - Rapids -

quite Extensive.

278½ Imburanas - Rapids - a little Fall of water, narrow channel best 2 large rocks.

277⅔ Faz.d do Araçapa (Island) Chapels - ruins Same name.

S. Miguel on the Rt. S. Felix on the left.

Almas - Rapids. From league 276 to 277½ complicated

Machado - Rapids



Counting up stream.

Parella de Cima - Rapids ("Panella" a pot.)

(The calm water of the river)

Whirlpool in three rapids.

near a Rocky Hill on left side.

Inhanhuns - Rapids.

River divides in many branches.

and the Islands (small islands) are very numerous.

Gros - Left side - a place, so called.

Estreito - Rapids.

Sacco Torto Rapids

Carapicho' Island.

Vieira - Rapids.

Fuzzo - Rapids.

a Fuzzo, as the Indians called it.

Telesphoro José Dias dos Santos Miller, land on I. d. Carapicho

268½ 550 Pop. BOA VISTA. Pernambuco Side On Hill of Rocks.

Reference on 3rd Sheet (of Translation) to Steamer "Saldanha Marinho" running (in or before 1875,) Come down to Boa Vista and back.

Below Boa Vista - The river was regarded as unnavigable - except by Canoes.

"Igreja Nova"

Built by a Lady, Mother of the (then) Superior Commander) Ola one on I. Santa Thomé 6 leagues below.

Cachão - Rapids.

Sant' Anna.

Walker Sept 8th 1879.

Counting up Steam –

Sobradinho – Rapids. 5 Kilometers below Sant' Anna.

Cachoeira do Vão to Boa Vista

La Called 30 Leagues.

Krauss Estimates Cask (Boa) 1,425: 000

If a consideration by Halfeld to Sant' Anna do Caetano (20: 000 Reis & Cam. Dr.) more from Pirapora to Sant' Anna do Caetano 4·X8 – 800 & ling, late Sobradinho – 2440 L. = 720 Miles!

he another plan his estimate 4 par. ab 63: 350 000

Low water – may to Oct. the Rapids of Sobradinho are an obstacle to free navigation, but it high water the current is the difficulty – Rain, and repea –

Halfeld made wh/ and down in his large boat "Princeza do Rio".

Halfeld's Ests Sobradinho

Approximate Plans. 390: 000 $ 000

B Affonso Plans. 420: 000 $ 000

670: 000 $ 000

Krauss – Est. Sobradinho 35: 000 $ 000

to Boa Vista 29: 350 000.

Sobr.

Halfeld urged no estimate comprom Boa Vista to Cachoeira do Vão = 30 Leagues without Krauss estimates 1,425: 000 $ 000. Making a navigation in low water for boats drawing 2½ metres. (3 feet 6 inches)

Krauss Est's based on depth of 1 metre 52 cm Chez Ordre

P.S. Have to touch a mountain 4 times in the 30 Leagues Boa Vista to Cachoeira do Vão

Comparing Halfeld's Notes – Vide Letter 3 Sept 1879 to Mr Bunch

Cachoeira do Vão to Boa Vista

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Comparing Halfeld's Notes – Vide Letter 3 Sept 1879 to Mr Bunch

(102) Utiahy Sept 9, 1879 Unofficial

To Commendador Dr. Dr. Luiz Pedro de Oliveira

Since making my formal examination of the most difficult series of rapids on the river above named, the Cachoeira do Vão and others, covering a league in length at that place; noting the general characteristics of the stream for a distance of a hundred Kilometers; measuring the volume of its low water flow here; and after studying the reports and maps of Engineer Halfeld and Keaus, as well as the graphic descriptions of Captain Burton and the excellent paper of Senhor Thomaz Gaeta Cardoso Mascarenhas, (published in 1865), I can assure that from my long familiarity with the phenomena of large rivers, I can now intelligently judge respecting the kind and extent of the additional information needed, and also of the best way to obtain it, in the shortest time.

I deem it a pleasing duty, in behalf of an absent gentleman, whom I never had the honor to know, Civil Engineer Halfeld, who surveyed this river in 1852-53 and 54, and whose report and maps were kindly placed in my hands in the city of New York by His Excellency Dr. Borges, the Brazilian Minister to the United States, to say, that they contain a large amount of valuable information, which must have been of great advantage to succeeding explorers, and which I am now sure will be of my great service to this Commission, saving much time, and enabling us to comprehend the main features of the stream more readily, and much sooner, and at less cost than could have been possible without these important aids.

I make this statement now, because it had been intimated, by different persons, that the data published in Engineer Halfeld's maps were largely fanciful. On the contrary, so far as I have had the opportunity of testing them, between the Ocean and Piranhas, and on the

* I do not refer to astronomical Directions, but to the delineation of the topographical features.

(103) Utiahy Sept 9, 1879

hundred Kilometers above the Falls of Paulo Affonso, they appear to be substantially correct, quite sufficiently so to aid us essentially in our present season's duty.* True, Mr. Halfeld's maps and report do not contain all the details needed by the engineer in forming a path final plan; nor will this Commission have time in this present examination to acquire them all. Nor are they necessary, until the general plan of improvement is determined. I now believe that, with the aid of the surveys and reports of Engineer Halfeld, and Engineer Keaus, the whole of whose surveys the most difficult portion of the river between Sobradinho and Juazeiro, the Commission may be able to examine all the important points, to the upper end of the Sobradinho during the short period remaining of the low water season. Engineer Keaus' survey, during the most difficult portion, Juazeiro mandado.

All of the observers who have passed along the Upper São Francisco concur in stating that the serious difficulties lie between the lower end of the Cachoeira do Vão (239 leagues) and the upper end of Sobradinho rapids (299 leagues) covering 60 leagues; and that from Sobradinho up, for 239 leagues, to Pirapora, the river is already a fair steamboat navigation, needing only comparatively trifling work by the removal of a few partial obstructions to perfect it.

Hence, if the Commission succeeds in accomplishing the necessary low water examinations before the Annual rise reaches Sobradinho, the main object will have been secured during this one season. Unless the Annual rise should be unusually early we may get considerably further up. It is important that I should see the upper part of the valley, or as much of it as possible, this year.

This importance, to the study of the stream in its low stage is the observation of it in its medium or ordinary half-year height say in November and perhaps part of December. This I hope to do on my return.

Circumstances have already caused us to modify our original programme; and will do so again.

Our measurement of the low water flow of the river, at Atalho, made Sept 5th 1879, after reduction to the assumed line of extreme low water, gave 60,780 Cubic metres, or 2,150,396 Cubic feet per minute.

This would fill a Channel 271 feet wide, 20 feet deep, having a velocity of 4½ miles an hour. This is very large for the low water flow, and ordinarily, excepting in September and October, it is much more on this part of the river.

In 1852, Mr Walfeld measured the low water flow of the San Francisco at the junction of the Rio das Velhas, including both streams, and found it to be 19,140 Cubic metres, or 677,148 Cub. feet per minute.

That is, the Velhas adds 31½ Cubic metres, or two thirds of the quantity, from here, 942 miles below his point of measurement.

Even here, at the upper end of them 942 miles, the quantity flowing will fill a Channel 181 feet wide, 10 ft. deep, having a velocity of 4½ miles an hour.

These dimensions are given merely to convey a practical idea of the volume of the flow.

From the measurements, it is clear that there is, at all times, an abundance of water, and during more than three fourths of the year a superabundance for an excellent steamboat navigation if it be advantageously directed into proper channels. (The same may be said of the navigation between Atalho and the Falls.)

According to the above, two thirds of the present low water flow passing over the Paulo Affonso Falls comes from the tributaries below the Rio das Velhas; and as none whatever enters at this time from the lower tributaries, it is all furnished by the upper streams, which empty below the Rio das Velhas.

The upper tributaries are peculiar in a radically different from those below, in a



most important particular; While the lower tributaries are dry most of the time, and never furnish any supply when the river needs it, the upper tributaries never cease to flow, and they are all the time adding to the quantity in the main stream.

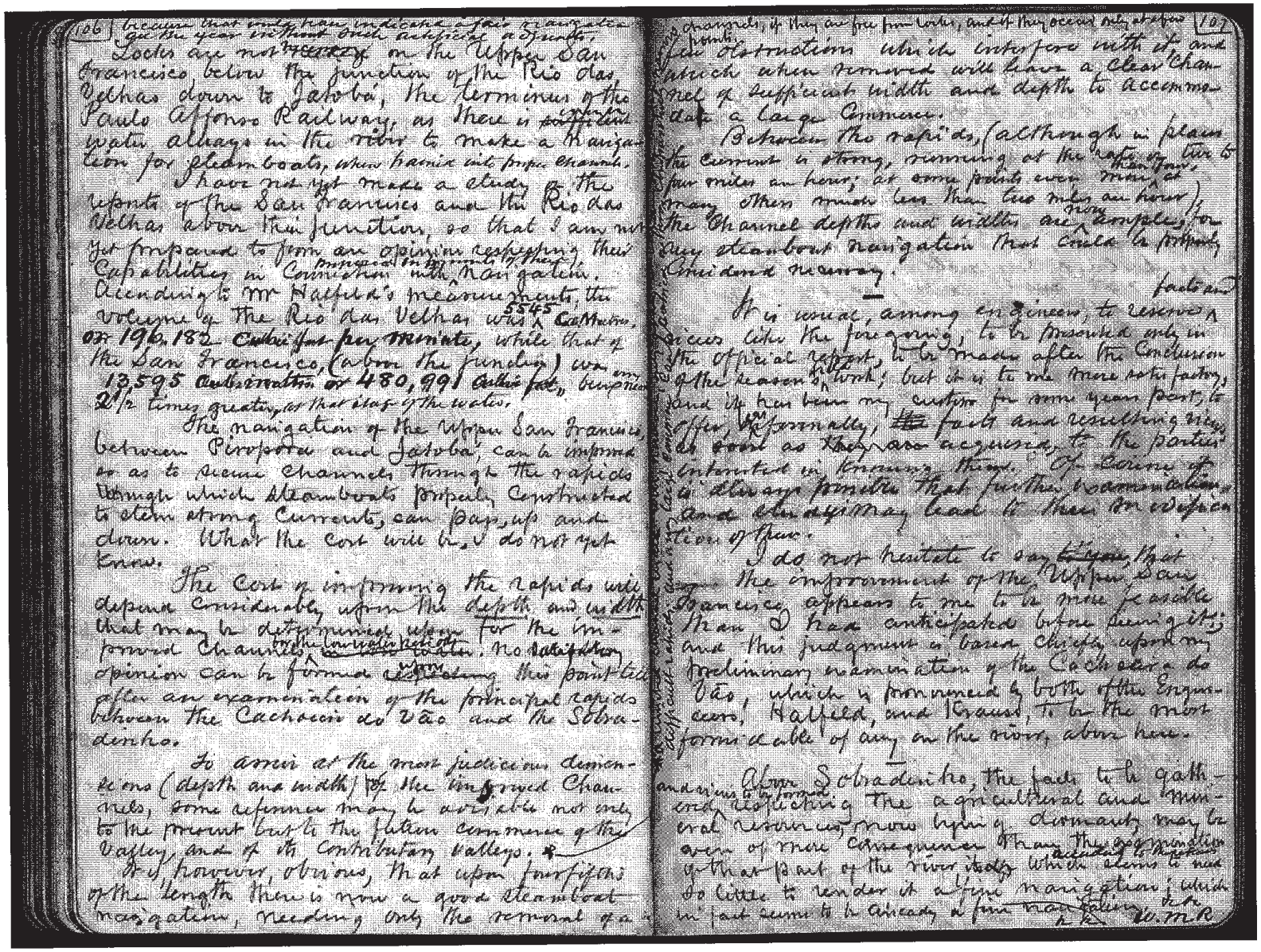
Of course this difference in the total Characteristics of the Upper and Lower tributaries, involves a radical difference in the Characteristics of their respective valleys, which must materially affect their relative Productive values. This is very much

The large uncertainty of water in the Upper San Francisco in its low stages, has a very important bearing upon its proper improvement. The engineer must being confronted by a narrow, gravelly, shallow, in front of the river, along the Atlantic slope in the United States, the Ohio, for example, the extreme low water flow becomes very small. At Pittsburgh, at the junction of the Allegheny and Monongahela rivers, at Pittsburgh, Pennsylvania, is 967 miles above its mouth. The San Francisco, at the junction with the Rio das Velhas, is miles above the Falls of Paulo Affonso. They have nearly the same length between the grand mountains. Affonso

But the low water flow in the San Francisco at the Rio das Velhas junction is over three times greater than the low water flow of the Ohio at Pittsburgh.

On the Monongahela river, one of the two great affluents which form the Ohio, the low water flow was found to be so small that Dreamondel, and also Comstock, a regular system of locks and dams (in 1839), which has ever since been in successful use; and at this time the government of the United States is constructing an improved lock and dam on the Ohio just below Pittsburgh.

If the low water flow on the Ohio at Pittsburgh, were as great as the upper San Francisco, I would not have recommended locks and dams for the Ohio river;



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[illegible] Boat only [illegible] a fair navigation for the year round such as [illegible] Juazeiro.

Locks are not necessary on the Upper San Francisco below the junction of the Rio das Velhas down to Jatobá, the terminus of the Paulo Affonso Railway, as there is sufficient water always in the river to make a Navigation for steam boats, when having into proper channels.

I have not yet made a study of the Valleys of the San Francisco and the Rio das Velhas above their junction, so that I am not yet prepared to form an opinion respecting their Capabilities in Connection with Navigation.

According to Mr Hatfield's measurements, the Volume of the Rio das Velhas was 5545 Cubic Metres, or 196,182 Cubic feet per minute, while that of the San Francisco, (above the junction) was 13,595 Cubic Metres or 480,991 Cubic feet, being 2½ times greater, or that stage of the water.

The navigation of the Upper San Francisco between Pirapora and Jatobá, can be improved so as to secure Channels through the rapids through which Steamboats properly Constructed to stem strong Currents, can pass up and down. What the Cost will be, I do not yet know.

The Cost of improving the rapids will depend Considerably upon the depth and width that may be determined upon for the improved Channels, to be taken. No satisfactory opinion can be formed respecting this point until after an examination of the principal rapids between the Cachoeira do Vão and the Sobradinho.

To secure at the most judicious dimensions (depth and width) for the improved Channels, Some reference may be had, not only to the present but to the future commerce of the Valley, and of its Contributary Valleys.

It is however, obvious, that upon four fifths of the length there is now a good steamboat navigation, needing only the removal of a few

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obstructions which interfere with it and which when removed will leave a clear Channel of sufficient width and depth to accommodate a large Commerce.

Between the rapids, (although in places the Current is strong, running at the rate of five or four miles an hour, at some points even more, at many others much less than two miles an hour) the Channel depths and widths are ample, for any steamboat navigation that Could be profitably Considered necessary.

It is usual, among Engineers, to reserve a few facts and Circumstances, to be recorded only in the Official report, to be made after the Conclusion of the season's work; but it is to me more satisfactory, and it has been my custom for some years past, to offer reasonably, all facts and recollections, as soon as they are acquired, to the parties interested in Engineering Works. My Opinion of a Channel from the Cachoeira do Vão, which is pronounced by both of the Engineers, Hatfield, and Craveiro, to be the most formidable of any on the river above here.

Above Sobradinho, the facts to be gathered respecting the agricultural and mineral resources, now lying dormant, may be a source of more consequence than the improvement of that part of the river itself. According to Hatfield which seems to me too little to render it a proper navigation, which in fact seems to be already a fine navigation for

W. M. R.

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Tuesday, Sept. 9. Atalho.

A warm day. Spent most of it writing a very long "unofficial" letter to Commendador, Snr. D. Luiz Plinio d'Oliveira — *See 6 preceding pages for a (nearly) verbatim Copy, or Original, rather.

—

I also began an Officio to Sr. Amarante, 1° Engr. thereby giving my Letter of instructions dated Augt. 6th — not being satisfied with the shape of it, I postponed it till tomorrow.

—

We have been in negociation with the owner of the barge who is here to take about 80 arrobas from this to Cabrobó. 31 Leagues, by river, at 6$000 per Cargo — or 1$000 per Arroba — and we are arranging the division, so as to take about the same quantity in each afternoon — when we get them packed.

Our crew have had rice and meat; but they have sent us no flour, nor salt.

Also arranged to send one Canoe after boards to Jatobá, hoping they may be there to night or tomorrow morn.

I am also arranging to make a small land party, to go as far as Cabrobó — myself, 1 Engineer Mr. Darby, 1 Cook, 1 Guard, and 1 man to attend 3 pack animals. 6 persons and 4 animals.

Sept. 10th. at Atalho 2500 ℔ to Sr. Amarante
1600 — on which Book
100 — Value

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Wednesday Sept 10th Atalho

Engaged many the day writing and copying letter Modifying instructions of Augt. 1879.

See pages 111 to 116 inclusive for Copy.

Heard that we had to pay 2$000 per Cargo for Capim — which we have undertook at 1$000.

We are now getting (8 miles off) a Cargo 1$100 — we gathering and bringing it, but not only refusing it, as the men threw cake others do the like.

—

Our Canoe, which left Floy morning at 6 o'clock for Jatobá came back at 4½ this evening with 40 boards (out of the 72) which I sent them to exchange for our Canoes. The boards are Cedar of the Country — very light than pine about 9 ℔ to 9½ to the foot 6 to 9½ inches wide 11 ft 8 long 1 inch thick. These 40 boards weighed 1000 lbs — with 3 men say 500 lbs = 1500 sank the Canoe about 7 inches — leaving about 8 inches above the water.

The two Carpenters are having sent tomorrow morning down the large heavy canoe — they have to divide it in two pieces to be carried by

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Ubed. Sept. 10, Cont.°

This morning, in presence of Sr. Sabria, I handed to Sr. Amarante two packages of money Brazilian Government notes.

One Containing 1500$
One " 1000$
2500$

This is part of the 4057$ I rec.d from Chefe Knight in Pirahos. The 1557$ I have, and I am accountable for only 1557$
Sr. Amarante is accountable for the above 2500$000

See page 117 for Septr 10th Journal.

"Companhia Hydraulica" Ubatiba, Sept. 10, 1879
Mr.no Snr.
Dr. Ant.o Pereira Amarante
Primeira Engenheiro
Ubatiba.

Owing to the limited accommodation in the Canoes and the manner in which they will be towed up the river, it will be necessary to modify my instructions dated Augt. 1879.

Only such of them as can be conveniently adhered to will be carried out.

The daily Maps, in double Hassler scale, may be dispensed with. Instead thereof, Sketch maps, only at the rapids, will be made, drawing to double of Hassler's scale. The Channels, Islands, rocks, deep water, and falls: and as nearly as it can be ascertained approximately, the rate of the swift Currents.

In those portions of the river, Hassler's Maps is to be used as a basis; and new information, and Corrections, where necessary, are to be marked on the Maps, in pencil.

Regular Soundings are not now expected, as the Canoes are not likely to be made in the Channels. Soundings, when taken should be recorded, especially any below two metres; but in such cases a note should be made, stating whether there is deeper water in the Channel.

Only one Cross Section need be taken below Cabrito or any convenient place that may be selected.

Our Observations will be mainly directed to the rapids, where if necessary the Canoes can be towed. On other parts of the river they should advance as rapidly as they can.

The principal point, at a rapid, is the position of the Channel (or Channels, if more than one) its shape, and Character, the rate of the strong Currents, and (roughly) the proportion of the whole river flow in it, when it

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is only apart.

Generally, where a rapid is not complicated or very difficult the main features can be ascertained and noted without stopping the Canoes for the purpose.

At difficult or bad rapids, time may be taken to get clear Sketches. Accuracy is not expected, nor is it necessary, in the present preliminary examinations; but it is desirable to have clearly what the Ship difficulties are, and about the widths and depths of the low water Channels, as they exist, and the position, extent, and nature of obstructions.

At the Cachoeira do Vão, and the other rapids, Caracha, up as far as Rodeador, four or five days may be required to get the needed information.

A level should be run, so as to get the fall and distance (to be taped) from the lower end of the lower rapid, on the Pernambuco side of the Sorobabé island, to a point just above Jacumba rapids, (about one league of leveling) Note of the positions, etc, of the different rapids in that branch of the river to be taken by those who do the leveling. The Transit line can be run at the same time from the same stakes, and Courses taken that will assist in Correcting the Sketches and Maps. If two can be found near the beginning and ending Bench marks should be made and marked

# From the examinations I made, my present impression is that the Steamboat Channel can be made at low costs, and with an easier descent, on the branch along the Pernambuco side. If not all the way from the head of Curia island, at least from where the Canoe Channel now comes

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over to the Pernambuco side from the main river. A cheap dam, of loose rip rap of large stones, thrown out obliquely at the head of Curia island, can be made to guide into that Channel the additional water needed — provided other things favor that side for the Steamboat Channel.

I have no doubt that a low water steamboat navigation can be made through the main Channel, where at low water, there are two Considerable falls; but it will probably be more costly, and have a much swifter Current than the Other, on account of its short length.

It will be necessary to run the Level along the Bahia side, also, to ascertain the profile of the river bottom, where the falls — say from a point four or five hundred feet below the lower one to a point four or five hundred feet above the upper one; noting, with the Level, the height of each fall from a point about 20 metres below to the same distance above each fall

If there are other falls above, you can judge whether they should be levelled around or not. Where there is no actual fall, and the Current does not exceed about 5 miles an hour, no leveling need be done (except that portion above designated along the Pernambuco side at this particular locality) Four or at most five days will be time enough to get all the main features, at this place.

According to Hassel's soundings, there is depth enough in the Lagoa Channel from the main stream over to a point opposite the head of the Island of S. Miguel along the present Canoe Channel.

If the Steamboat Channel be made in that direction, it will probably be necessary to make a low rip rap, dam along to the Island of Jacumbas, in order to hold the water to the Pernambuco Channel, and also,

below that, to close the main channels between S. Miguel and S. Antonio islands, so as to carry all the water brought in from above over to the one Pernambuco Channel.

Observe as much as you can respecting these points.

The rough stone dams appear to have only to be about as high as, or any little above the present surface of the water to divert it. In some cases "Cribs," built of rough timber, and filled with rough stone, may be employed.

I have already seen enough to comprehend the general character of the obstacles in the way of a good steamboat navigation on this river.

Where rocks occur in any channel intended to be improved they must be removed. Three plans are to mind.

The longer a channel can be made through any series of rapids, the better; as the declivity on a given distance is lessened correspondingly; but if a good tolerably straight channel can be obtained without having to much rock work, it may be preferable. Experience, and judgment, alone will solve questions when they arise. Velocities over 4 or 4½ miles an hour, are objectionable — they are not to be encouraged; though proper steamers can ascend them.

The works required to make a steamboat navigation on this river are chiefly at the rapids; and in [illegible] they are few, and simple.

1. The removal of obstructing rocks.



2. Closing Curtain island channels, with rough stone dams (rip-rap) or, in some cases, with cribs filled with stone, in order to divert the flow of water into some desired Channel, direction, or to prevent the water from being lost from the Channel.

3. Dredging, however, is required, in order to ascertain which is the best route to be selected for the improved or Steamboat Channel.

The Cause of the simplicity of the works required, is the very abundant supply of flowing water in the river, at its lowest stage.

If this quantity had been limited to a small amount, as it is in many rivers, the Cost of the improvement into a good steamboat navigation would have been much greater, and the works more complicated. In fact, if this river had no greater flow in its low stage, than the Ohio river (in the United States) in its low stage, it would not admit of a steamboat navigation during low water, except by means of locks and dams; the Cost of which, in this valley, would have been enormous.

After deducting one fifth from our measurement of the 5th of Sept. to allow for the lowest depression in the stream at this place, it still leaves 60,816 Cubic metres per minute or 2,146,800 C. feet.

Engineer Walfred in 1852, states the low water flow just below the junction of the Rio das Velhas (314 leagues above here) to be 16,140 Cubic metres, or 677,173 Cubic feet.

This is Six times the low water flow at the head of the Ohio river, at Pittsburgh, Pennsylvania.

now, a Channel 20 metres wide, 2 metres deep, flowing 2 metres per second, (or about 4½ miles per hour) would require only 11800 Cubic Metres, or 169, 824 Cubic feet per minute. Can we get that amount a good steamboat Navigation, in a tolerably fair Channel, free from abrupt bends?

Now the water flowing past Atalho to day, would be sufficient to fill 12 such Channels: and even the quantity at the junction of the Rio das Velhas, in low water, would fill about 4 such Channels.

During three fourths of the year the flow is much greater.

There need be no question, then, as to the practicability of having a steamboat navigation on the Upper San Francisco, without locks. What we have to ascertain is, the best mode of getting a fair Channel, at the least cost.

Wherever we find, already, through any rapids a Channel as wide as 20 metres, 2 metres deep, the velocity of which does not exceed 5 miles an hour, it may be safely called a fair steamboat Navigation — if free from abrupt turns. If however, our observations show that for a mile or day, it can be made safer, or better, that fact must be specially noted.

After the Communication has fairly started with me on the river, I propose to proceed in advance, to examine some points further up, and I will communicate with you from time to time. I remain Sir your obt. servt. H. Milnor Roberts Engr en Chefe



Atalho Sept 11. 1879

Lt. Reinaldo Von Krüger Engr en chefe &c

I learn that a man of to steer in a few minutes for Pirantinga, and having another ready I enclose it herewith — please mail it.

We sent a Canoe to Januaria yesterday, which brought us 40 out of the 72 boxes. We will probably not need any more. If there any left unused I will leave them in Capt Senhor José Manoel de Souza.

We are busy getting the Canoa ready. Their capacity being limited, we are obliged to send half of our Cargo by another Canoa to Cabrobó. We expect to leave here within two or three days.

Thanking the honor to remain
my esteemed Friend
Yours truly
H. Milnor Roberts
Engr en Chefe

P.S. We hope to receive mail from Pirantinga before we leave.

Rec. this morning from Sen. Amarante Cod 000 } 60$000!
It being the sum I let Rudolph } 60$000!
the Steamer Engineer have
at Pernambuco.

Capt Antonio

The owner of the barge here, sends word that he is ready to load to day, and start tomorrow for Cabrobó. He will take up Cargo (31 loads) for 18000 per arroba — We suppose about 80 arrobas can be sent that way.

12 arranjar Mr Cert aug 31

We started the Canoa Cargo to day with 60 thousand reis & a steamer must Capt. Piranhas. We working well.

Cabrobó Sept. 12 1879

Sthe Hames.

Sandstone formation, Arkose

Cabrobó

Manoel José da Rocha Lopes

Passaporte para [illegible]

Cabrobó

Cachoeira do Vaz

" de Cruzeiro

" do Espinho

" do Taquarinha

" dos Cavallos

" Furna Olhos V.

" de Redondas

Miss.ão de S.B. de

Cachoeira do Cortume

Salitran de Barro

Cach.a do Boa Velha

Taz.a da Cachoeirinha

Salitran de Cima

Passagem

Cach.a do Ramalho Grande

Arabicum e Serrote Preto

Arripio

Cach.a do Cumbe

Ringue

Cachoeirinha

Cach.a dos Flores

"

"

Riacho Mel

Cach.a do Pandeiro

Cach.a do Cabrobó

Cabrobó

Sept. 13th 1879

Sunday after Rain

Barometer 8½ inches

| | | |

Sept. 11. Thursday- Atalho.

Continuation of Study of the Rapids from Sobrobabe to Cabroda. 16½ Leagues = say 48 miles = Fall say 149 = 3.15 ft. per mile.

Remarks.

Ordinary Stern-wheel steamboats of light draught can the upper Allegheny River (the larger of the Confluents which form the Ohio river at Pittsburgh), forty years ago ascended the stream where the fall was 4 ft. per mile, the water flowing over a gravelly bottom.

The stream being comparatively shallow, the velocity of the water was considerably retarded by its passage over the gravelly bottom and sloping sides of the Channel. The precise measure of the retardation from this cause was not ascertained. It would vary materially with varying depths of water.

The actual amount of friction would average with an increase of the depth of water, from two causes; namely the greater wetted perimeter, and the augmented velocity due to the effect of gravity; but the proportion of friction, compared with the moment of volume of the flow, would be less.

So much depends upon the character of the bottom and sides of channels, and the quantity of water passing through them, that it is not only difficult, but it is impossible to use any formula, without special



Sept 11th Atalho - Continued.

Remarks continued.

reference to the particular case to be considered.

A formula for canals of any size and any shape, which will safely, under similar circumstances; but these are rarely similar.

The circumstances at the different rapids on the Upper San Francisco have the general resemblance of having all rock bottoms and sides mostly irregular; but having various degrees of declivities and depths in all and shapes. But nothing short of actual observations and experiments at each rapid will give the depth and velocity at a given stage of the water in the river. The size and shape of the Channels at each place, in connection with the depth and velocity, will give the character of the Channel, and indicate the nature of any improvement needed to make it better, at that particular stage of the river.

At the first view, the natural impression would be, that the numerous rocky rapids in the Upper San Francisco, possessed no redeeming features; that they are only unmitigated evils; and the sole obstacle to a good steamboat navigation. That if they were smoothed down to one inclined plane from Piraporá to the sea, there would remain a perfect navigation.

Let us examine this point. According to Engineer Halfeld

the total fall is 1711 ft in the distance of 1143 miles, or at the rate of 1½ feet per mile. Bottom slopes
If the stream had a smooth ^ with a regular declivity of 1½ feet per mile, ^ a given quantity of water would pass from the head waters to the sea in much shorter time than it does now because it would have a greater average velocity. The low water period would occur sooner, and the depth would be less during the low water stage than it is now, (excepting certain falls and rapids) and when low it would not rise as rapidly as the pools as it does now along the present pools.

It is true that with a rise of that inclination, having an abundant supply of water, enough to give a depth of 5 feet in the low stage, (with a smooth bottom and sides) an average velocity of about 3 miles an hour, would be a grand navigation.

But could it be so? The river has an average width of more than 2000 feet for hundreds of miles. Carrying at 2000 ft wide, and 5 feet deep flowing at the rate of 3 miles an hour, what is the quantity of water required? It is 2,640,000 cubic feet per



At the present time that is in fact about the quantity now flowing at this point. Comes in at the sides through a thousand miles of bends, irregular rocky Channels, and through deep pools where the velocity is greatly obstructed.

In the case of the imaginary river that quantity of water would not be on the move in the place at this time, as a much larger Prism would have formed in the Channel.

But again, it is to be considered that the San Francisco river is sui generis, differing from most rivers, owing to the magnitude of its low water flow.

The confined channels through the rocky rapids necessitate depth- the same width in the pools, occupying a large portion of the width of the stream, necessitate depths in the Channels. These circumstances, therefore, are not unmitigated evils, since they serve to maintain a deeper navigation, and for a longer period.

9 P.M. - Sept. 11th -

Evaporation 1/8 inch in 2 hours - Large bucket of water - not very accurately taken - from 1½ to 3½ P. M.

See page 118, for my letter of this date to Sr. Tente Coronel José Soares de Mello Avellins, at Cabrobó, sending to his care a cargo per the barge owned by Sor. Manoel José de Brito.

I also sent the Letter of introduction written by Sr. Cavalcante

—

I went down to our Canoes several times to day, to assist in planning the manner of changing them to Ajojos. The Carpintarias are doing it well.

—

I arranged to dispense with 2 of the "guard" Party- leaving it 12 or four as agreed- & Mr. Kruger wrote to Mr. Kruger, as follows:

Letter to Mr Kruger. Sept. 12th

"Our Canoes will now soon be shaped into "ajojos." We have sent by a barge which carries down hence, two thirds of our cargo to be delivered at Cabrobo to Sr. Tente Coronel José Soares de Mello Avellins, to whom I have a letter from Senhor Cavalcante.

Two of the men of the Guard return to day to Pernambuco, though there are still twelve, including the foreman, which I understood to be the number you had designated. I am willing to retain that number, but no more, as there is scarcely any thing for them to do. I have allowed the two men to take with them one Pistol- and their wages are paid to them here, including 2 days allowed for returning to Pernambuco.

We are hoping to get some mail before we leave. I will write again.

I am the honored Roman

H. Milner Roberts
Engineer

Calabo Province of Pernambuco, Brazil.
Sept. 12. 1879.

John Bogart Esq.

My dear friend:

Here we are, in excellent health and spirits, about 204 miles from the Ocean, encamped on the left bank of the Upper San Francisco river, and about to move, (after Breakfast, on board of "ajojos" made by ourselves by "trimming" two Canoes into one double-bottomed boat. (I have the honor to submit to the Society as new, not found in previous publications, the word "trimming"- as above substantially set forth.)

On our way from Piranhas, the town at the head of Good navigation on the Lower San Francisco- miles from the sea, (and where the river is about just above ocean level) we rode over the line of the Paulo Affonso Railway, now under government construction. It is 72 miles long; its max. grade, in one place, in getting up from the Lower river valley to the general plane of the Country, is 3 per cent, its minimum radius of curvature 260 ft- Generally much larger radii- gauge 1 meter.

There are about two thousand laborers engaged upon it, nearly all of them being refugees from the districts of Pernambuco, and Ceará, which have been so terribly afflicted with drought, famine, disease and death, for several years past.

We turned off from the railway route a few leagues to our left to view the Great Falls of Paulo Affonso. We arrived there early one afternoon, encamped, and remained Kroeger examining that my intention was to go on the next afternoon.

There is only one habitation there, in which dwells a "Portuguese" Indian, who is not ashamed to own that he has only ten children; but as he is young, etc, etc,

Sept. 12. Friday. Catalho
Letter to Mr. Bogart.

allow me to submit, also, the word "portuguesed" I mean, that the Indian language soon has been driven out of him and that he is now fully impregnated with the Portuguese — a la Hayward process, I suppose. He was friend, and a "guide" he wanted to be; but the "American" portion of the expedition recaed no such article. We all made our examinations each in his own way.

The Falls of Paulo Affonso were not made for the purpose of comparison with the Falls of Niagara; though they may have been formed about the same time, for any thing known to the contrary, the only record we saw, except that of the rocks and water only going back to 1859, when as the inscription engraved upon monument set in plaster over the Emperor Dom Pedro Segunda visited the Falls. The Chief object of the inscription appears to be to immortalize the fact, that the design of the thing was by Engenheiro Carlos de Morray, who in 1869, gave birth to the thing in the City of Pernambuco.

Leaving out this abortion, Nature has attended to her business in this vicinity most faithfully, and a grand work has been produced. If I described it well, as a poet, with my eye in a fine frenzy rolling, I should only make a transcript of Capt. Burton's description published about ten years ago. Though verbal descriptions of such objects are of little use to those who have not seen them.

These falls are "rockier" (another word, please) than those of Niagara, they are also narrower, crookeder, more Cascadier, less profundiadier in one bumbee; but more dashing and impetuosier, and picturesquer.

At the time of our visit, (August 25th 26th)

Sept. 12. Friday. Catalho (127)
Letter to Mr. Bogart.

the river was in its low stage, but not its extreme lowest, by about 18 inches; yet the quantity of water then foaming over the falls (as afterward measured by us in the river some miles above) was enormous — over 2,500,000 Cubic feet per minute. 2500 x 40 x 300 per min = only 30,000,000 cubic feet per minute.

I make the extreme low water flow, according to the best data we can get, some 2,146,800 C.f. per minute. In flood, the upper San Francisco, averaging about half a mile wide, near 20, 25 and at times 30 feet, so that in a grand freshet, the [illegible] jagged, craggy, water-worn, black, porphyritic rocks, which now constitute the prominent feature of the Black-Creek looking landscape, are all covered with the mad torrent, which then must roar, tear and rage out to sea at. In less than a mile the river falls 260 feet, over a higher bed than I have before seen. The greatest vertical fall in one place is perhaps about 50 feet, and the stream is divided by a rocky island. Rocks, rocks, nothing but rocks, and water. I cannot take more time to attempt the impossible task of conveying to you an adequate conception of this Brazilian Wonder. If there had been no Niagara! — well, there could have been no Comparison. But as Niagara exists, some people will compare them.

The Emperor's contentions opinion is probably as good as can be used. After reforming his both, from personal observation, he said "They are different."

The river San Francisco is also different from any river I have studied. As yet I have seen a little less than One hundred miles of the Upper river, above the Falls. I have examined the Cachoeira do Vão, 45 to 50 miles above this place, and to be the more difficult in the thousand miles proposed to

be improved, and also several minor rapids, and having with me the excellent maps of Halfeld, the German Civil Engineer who surveyed this river in 1852, 53 and 54, I can plainly see that the general Characteristics of the Stream are the same all the way. Numerous rough rocky rapids, with intervening sloping pools of various velocities. Every portion of the Stream above the upper terminus of the railway, can be passed by Canoes and small barges.

The portion which is grievously afflicted with rugged, rocky rapids above Pirapora Point, at Sobradinho, to the upper one of the Sobradinho rapids, covers about 216 miles. Above Sobradinho for 720 miles there is always a fair navigation; only here and there a few isolated rocks, or rising obstructions to be removed to make a pleasant, in fact, they have a steamer running on that part of the river.

The great Characteristic, and vital advantage of this Stream is its abundant supply of water even in its very lowest Stage. At the function of the Rio Velhas, 962 miles above here, the low water flow is 8½ times that of the Ohio at Pittsburgh!

Not having yet seen the middle and upper portions of the Valley, I am not yet prepared to offer any description.

The lower part of the valley, above the Great falls, is peculiar; quite different from our American river Valleys, and quite unlike other river valleys in Brazil.

The great annual rise of the river, 20 to 30 ft. overflows the marginal river slopes and keeps there a supply of fertile Alluvial deposits. These slopes, after the subsidence of the floods, are cultivated



all along on one or the other side and some places, in this straight reach of the river, on both sides; in a small way, raising vegetables, Chiefly melons, sweet potatoes, Indian and beans, with a little corn, and capim (grass).

At frequent intervals houses occur, situated on the top of the river bank, above the floods. They are composed of clay and sticks, with doors and windows but no glass, and tile roofs. There are inhabited, generally each house has at least one man and woman and not less than ten Children, the younger ones being, unlike the Chickens, without feathers; and the older ones not having so much Clothing, the clay climate being very warm; although thus far we have found the nights Cool, and we have not encountered the pest of Mosquitoes.

The high flats, which in a former age were formed by the river, are now for the most part above the highest floods; and many patches have a good soil, but in no instance have these ever been Cultivated. They extend from a half mile or less to a mile or more before the land rises rapidly, and then, as a rule on this part of the Valley, the slope is very gentle.

The flats are nearly bare of vegetation, the rolling hills have a meagre, aborted growth of Scattering low and large Cactuses, which have been counted as a foot in diameter and 30 ft. high.

The Sertão covers a very extensive region on both sides of the river; the Province of Pernambuco on the left, and Bahia on the right bank, and fortunately it affords some pasturage for Cattle and sheep and horses.

There are houses in the Sertão, but they are made like those along the river, and are inhabited by the ordinary Brazilian people. Although all the flats are green with grass, yet here there appears to be some

flesh than grass- Cattle, sheep and Children being the ^grandest product.

Now, while water is the Characteristic of the river, drought, is the prevailing Characteristic of this part of the valley. We cross rivers whose beds are perfectly dry, and which, owing to the drought, have been so for several years. Not a drop of water comes in from any direction for a long distance, and below, the ^river bed is dry. In the little valleys of the ^gently Sloping Sertão the proprietors of the- the Settlements (They are not plantations, neither are they farms, nor farming, as we understand it is understood.) I do not know whether there is a plough in all this part (as in any part) of the Valley. They run up earth mounds to Catch some acres of water when it rains. A rainy season is due and over due, but the rain does not always Come. This reservoir gradually evaporates & leaks away meanwhile Entertaining Cattle and people. By and by it disappears from the surface of the ground- then they dig, and find water. It sinks gradually lower, and they follow down, digging deeper; but at times age these efforts become useless and they lose their Cattle.

They have milk and use it to make Cheese, but recently they have had to give the Milk to refugees from the suffering regions further in the Interior.

Much ^ different further up the river, because there the tributaries flow perennially, and the towns are known to be important. The Change may be gradual- from the Comparatively trifling production here to better production further up. I hope to see it.



One thing is cheering to the engineer. With the large quantity of water flowing in the river, I am encouraged to hope that a fair steamboat navigation may be secured on the 216 miles referred to, without too great an expenditure of money; but water is one thing, & Canoe this is no more than a hope.

The water is here to for irrigation of these high flats. The river, down to the great falls, has an average fall of over one foot per mile. Strong winds blow this whole day, 24 hours, which would pump up a large quantity of water; which, if raised at the upper end of a tract, Could be drawn over the whole; for many of the flats are lower a few miles back than they are at the river bank.

The sky, and the clouds, over the river, by day, are as bright and beautiful as those of Italy; but the Meteorology is widely and Oddly different for this region. By night, the stars and the planets - Venus, Jupiter, and Jupiter among, are as Brilliant. We have the moon for some time with her charming face shedding splendid light over the Charming landscape of the river and the opposite shore.

Sir Christiana lends much amusement to the scene; for when you go over there, there is the Sertão. The hills over there are steeper than they are on this side, and marked with deeper gullies.

We are an escort. 37 of us all told; probably 12 are an armed guard. I wanted to go without them; but having been advised by those who ought to know, to take them, I am not now inclined to take the responsibility of discharging them. Thus far they have behaved pretty well. We ate an ox in four days.

Time rolls on- This letter may not reach a mail for several weeks, it cannot get to an American steamer before the one of Oct. 5th. If

Sept. 12. [132]

Letter to W. Bogart.

until a week to about the end of October before you can get it. In Nov. is our annual election. Unless you have written telling about the nominations, I will from writing till after the election. I hope that the present dynasty, excepting of course myself, will be continued, and especially that you will remain as secretary, and Mr Coon as treasurer.

Perhaps after this year I may be situated a little differently. Now, my whole time and personal attention are constantly, not merely daily, but hourly, given to the examinations, observations, manoeuvres, official Communications with the government, & others, & occasional letter, like this one, may be written by jerks — stumps & rains, interruptions; but if I shall, thereafter, be spared & enjoy a similar degree of my health, and my readjustment the same, I think we may be able to make good report of our season's work notwithstanding the delays which have retarded our operations thus far.

I will enclose with this a check for $25, to pay my year's subscription. Exhaustion might be claimed for a part, in the form of absenteeism from New York, but I do not wish it so; I prefer to be regarded as retaining mind as set on a picnic, retaining my status as a New Yorker, in Connection with this our Union, & other societies. I may tell in Rio de J. by a young engineer friend that I was elected a member of the Polytechnic Institute; but being born in a Slave state may make a mark a home, such I suppose that will not make me a Brazilian. However, I have always, since my first visit in 1858, had a high opinion of Brazilians, and of the Brazilian character, than any of my colleagues entertained;

Sept 12. [133]

Letter to W. Bogart.

I am looking for a mail to arrive tomorrow, or Sunday, per our two-legged horses. I had thought we could get away from here before Sunday, but I now think our regular start will be on Monday.

Please give my kindest regards to Mrs Bogart and all of your family, and to all our friends at 124 E. 20th.

Very sincerely your friend
W. Milnor Roberts

P. S.
In the case of any
Army letters — if there are
Things in them which in
your opinion would be attracting to our
fellow travelers, please use them, at your
discretion; strongly cut from Front, or
otherwise.

Also.

Letter to W. M. Lansdale
4 pages — Paulo Affonso — and
Christoval of the Valley, with Sketch
of an agreement — and of a house
and shed for me —



Enclosing Check
for $10.00 (ten) to help
keep my account up

Dated Sept 13, 1879.

Sept. 13. Sat. Atalho.

Mail Arrived

Two letters came from Addie, 1 from Col. James two from Mr. Krueger one Officio from Wilkens Martin, Director Obras Publicas (ans. at once) Rio News of 5th & 15th. Other Letters for the party— none for me from the United States.

The Officio related to the tax matters connected with payments on the Santos Improvement duty— and Sr. Amaranto prepared an answer stating in effect that the tax had been paid, and the City Treasurer giving but that they could not be responsible for our return, as the papers are at Piranhas.

One of Sr. Krueger's [official] letters relates to the Arrival of the Launch Paulo Affonso. and to the Contradiction of the statement that the rations had been reduced, to the families of some of our men who had been engaged for us by Mr. Krueger, as a Guard.

The other relates chiefly to Sen. Cavalcante's Letter dated one 10th the other 9th

In the evening came a special messenger with a third letter from Mr. Krueger, dated 11th, enquiring me for instructions, Concerning the Launch Paulo Affonso. I had nearly finished my Official Letter, answering to his of the 10th I now add in the same sheet answer to his of the 11th.

Atalho Sept 13th.

Copy of Letter.

Illmo Snr.
Dr. Reinaldo Von Krieger. Engr. en Chefe &c.

I have the honor to ack. receipt of your letter dated Sept 10. in answer to mine of Sept. 5th.

I learn from it that the statement made here that you had reduced the rations is false.

I did not believe the statement, but it seemed proper that I should be assured of the truth by yourself.

I do not wish to Change the arrangement you made with the Foreman of the Guard.



Sept 13. Sat. Atalho.

I am glad to learn that the Launch Paulo Affonso has arrived safely at Piranhas, and that the Engine is near by in a Canoe, at the same time I have to regret that we could not at present use her here on the upper river.

I have no means of knowing what the wishes of the government may be respecting the Launch after they learn that all Communication with her is impossible on the upper river. In a letter to the Government from Piranhas, I suggested that, in case she could not be used here this reason, that she might perhaps be made serviceable between Piranhas and Pombal, etc, but I have had no official notice from the government on the subject.

I should think it would be proper for you to telegraph to Dr. Rhein asking what to do under the circumstances.

In case the Launch is not to be used in any service this season, I scarcely know what could be best in regard to Rodolpho, her engineer. He could be of no use to us here on the upper river.

Could you find employment for him on your Ships? Perhaps you could set up the Engine in the shop and make it do some work!

I expect our Ajoujos to be ready so that we can leave here and go up the river on Monday the 15th. I do not think we will be further up than Cabrobó during this month. #

I had written thus far when your letter dated Sept. 11. came by special messenger.

Dr. Rodolpho was not authorized by me to employ a fireman, at all. I do not know whether any one who has the right authorized him to do so. He is correct in saying that he was engaged at 150$ per month and his expenses to be paid.

The suggestions I have made above are for your consideration.

In regard to the distribution of the

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launch I do not know that it is to rest upon any determination of mine. I do not know what the views of the government may now be.

I have not been called upon to decide what is to be done with the launch under the existing circumstances.

I have never had any instructions about sending the launch from Piranhas. You were directed by the government to procure a Carriage and take the launch overland to the upper river. I am not authorized to rescind that order. I do not know what the wish of the govt may be when the shall have learned that the launch cannot be used by us in ascending the upper river this season.

If I were in your situation, I would not take the launch out of the water till after telegraphing, and having a clear understanding with the government respecting the best course to adopt.

I feel a delicacy about offering advice to the govt before it is asked for. If my advice were wanted or needed. It would be given to this effect: Namely!

1st To leave the launch in the water!

2d To put the engine into her — provided a Steamer is sent for that purpose on the lower river — Otherwise to leave it out.

3. To employ the Engine on shore, if I could, if not, to put it under Cover, and take care of it.

4. To employ engineer Rodolpho (if I could) in Piranhas; if not, then to pay him off, (to some date) paying his wages, and proper expenses — over to the 1st of Nov. including his passage to Rio de Janeiro.

Perhaps Col. Pliniz would take some interest in finding him employment; if any. I don't know the other particulars of his engagement; but Dr. Pliniz does.

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5th To employ the fireman (engineer) Rodolpho) at some other work in Piranhas, (if I could). If he is not willing to remain and be employed, I would ascertain exactly how he can be employed; and act accordingly.

I desire that you will send to Dr. Pliniz in my name, a telegram as follows:

Atalho Sept 14, 1879.

"Since telegraphing the Conditions of the river, I have heard nothing in reply.

In the absence of special instructions I advise Dr. Krieger to retain the launch till further orders from the government.

We have Comboucha two days provisions.

Tomorrow we move up the river, hoping to reach Cabrobó this month.

W. Milnor Roberts
Engr en chefe.

I have the honor to remain &c
W. Milnor Roberts
Engr en chefe.

Atalho, Sept. 14th

Col. O. C. James
Rio de Janeiro.

My dear Col:

answer to this of the —

The evaporation to day from a bucket of water at 1 m. [illegible] from 11 a.m. to 4 p.m. (5 hours) was 3/4 of an inch.

At 1/2 of the time half the surface of the water was shaded by the rim of the bucket — and at 4 p.m. the entire surface was so shaded, the bucket being only half full.

Letter to Dr. Com.r Pleniz

Ataího Sept.14th

Illms Exm.o Snr.

I han the hinor to inform your Excellency that Our agoja is ready, and I have arranged to move up the river to the Cachoeira do Pao, tomorrow the 15.th instant. Last evening I receivd from Chief Engineer Kruger word that the Launch Paulo Affonso had arrived at Piranhas, that the Engineer Rodolpho was also there, and that he (Rodolpho) had hired a fireman, at Penedo, who was also there. Mr. Kruger writ to me asking for instructions.

I answer his letter, in effect, that I do not feel authorized to exceed the instructions he may have recd. from the Government Concerning the Launch; but ordering him to do nothing with it but communicate with you by telegraphing, until he has a clear understanding of the wish of the government after it shall have learned that the Launch can be of no use to the Commission in ascending the river.

In addition, in the case of Rodolpho, the Engineer, whom you engaged, will of Course depend upon the decision of the Government respecting the Launch.

I have merely suggested to Mr. Kruger what I would do if I were situated as he is. I then authorize and request him to send, in my name, a telegram to your Excellency, as follows:

"Since telegraphing the condition of the river, I have heard nothing in reply. In the absence of official instructions I advise Dr. Kruger to retain the Launch till further orders from the Government.

To-morrow Continue my journey. Tomorrow we move up the river; hoping to reach Cabrobó this month

Mr. Minor Roberts Engr on Chefe



Continuation of letter Dr. Com.r Plenio.

After leaving here, our mail facilities will not be so good as they are here; though we have received my letter; although our Man on foot expresses goes through in two days between here and Piranhas.

My plan when above here for some time, is to have a mail sent weekly, from Piranha, to Jatobá, after the arrival of the weekly Steamer (the Sirinhaem) at Piranhas; While we send down weekly, to Jatobá, our mail, and receive whatever may be there.

After reaching Cabrobó, which is above several difficult places in the river, I will be able to judge better as to our further progress up the river.

I made a trial trip, with our boats, and found that we made much better headway with the wind, blowing up stream, against the river Current, than the men can make with oars or poles. They have never used sails on this part of the river; but I perceive no reason why they should not be used to advantage, and the Com.n of Labor and are available in a strong Pair, bring better management of the Chanoels.

All of the Commission, and Dr. Derby, geologist, Continue in good health. Thus far our demands have been much stronger upon the Larder than upon the medicine Chest.

The Country a few leagues away from the river, on the Pernambuco side is better than it is nearer to the shore, as at Jacarate, four and a half leagues from Ataího, where there is a little, and some cultivation.

We hope to find the Country, generally, improved as we advance up the Valley.

I have the honor to remain &c

See page 141 for Post Script.

W. Milnor Roberts Engr on Chefe.

Monday Sept. 15th. We leave Atalho at noon.

We sent our last mail from Atalho last night.
This morning is occupied in loading our 2 Ajoujo and one Canoe. We have about 10 of our boys in Care of Snr Manoel de Souza. who brought all Canoe down to the river and Bade us "bon viage".

The two Ajoujos and Canoe were pretty well crowded with our things; we bring a number of boys with us in the small Canoe.

At 12, noon, we start, with the Cargo Ajoujo all of the Commission and Prof Derby on board, with Henrique and Chico and the two Carpenters and the Crew of Indians 4 fine neat young men and the pilot.

The second Ajoujo and the Canoe, start a little later - 10 minutes or so.

We have up sail, with a nice light breeze and with the help of the oars worked our way obliquely across the river, and keeping the wind always astern or being unfavorable, we were poled up stream for an hour or more, then a little sail help - then poling, still holding to the Bahia side.

We send 3 Canoes & our Ajoujo on 3 hours, and some horses with saddles to Cancella at the Point of the Papagaio mountain. There to await our coming. They go across the Curve in the road which is not over 4 leagues, while our distance around is 8 leagues.

At about 5 1/2 miles from Atalho, just at the point of Rocks on the Bahia side - See map - I must on my reading depart for the point of rocks above on the Pernambuco (or right bank) after a little demurring on the part of the Indian Pilot, who is very accustomed to sailing, and wanted to pole up further, I carried my point by peremptorily insisting upon it, and we soon had a nice little breeze which carried us just where we would go. The first point of rocks we came to on the Pernambuco side, was low,



black & jagged - a boy and a man picturesquely fishing off the point fishing bow hanging rock - rise on 18 ft, above the river - a little way above we came to a very prominent ruby projecting bluff to the river, a termination of a ridge - this side does not approach on the Bahia side (where it is flat - for several miles - probably) we keep over to the river - for there are extensive bends in the River along here -

A Mile & a mile above the first prominent projection of Sand Stone rock is another ornamental similar - these are the first one not bare and the second more than 100 ft above the water -

There are on the rocks in the river and at its edge, fallen from the main mass bare, water worn rocks Curiously marked with parallel lines & indentations not shingle, but like roughly Chiselled marks -

On the same time passing Indian huts - Indian trees that were 60° or 70° from the shore on deck -

Many Canoes are now to me. the great many of these made of mud. They are natural - not artificial

At 5. P.M. - between the two Ilhas mentioned - Proposing pouse - about 3 Leagues - 9 miles - 13 Kilometres we stop for the night - the other boat not being in sight - and they have the Consumen and tents on board -

At 5.35. the other two boats sailed up beautifully & are now satisfied - that our choice of delays at the rapids in Canoe make seven eight leagues per day - if the wind favors in half the time. Say - L. 3 1/2

## CAMP No 3. League 3 1/2.
## Serrote de Sobradinho
## REPORT. 1. (or Sobrado of Halfeld.)

From Jatoba at League No to this place at [illegible] new League No. There is only one rapids of Consequence, namely that of Vargem Redonda about League No 3 1/4. Through that rapids There is a good natural channel of sufficient depth, and

Tuesday Sept. 16th. Leave CAMP 3. 8h 11m Last Start at 8h 29m

Light breeze with mist - Course a point W. N.W. (above the high rock) but that to N.W.

8h 38 - Opp. W. pt. of High Rock - 9 Metres sounding; but deeper in mid-channel. The tide was dead, with moderate wind - 3 Loggers "A NWA" seems to beat us this morning.

Above the big rock are other clumps of earthy objects and sandstone rock - These are the "Pedras" shown on Halfeld's map.

Along shore, on both sides of the canal river origin called P. 42 - are a sand and gravel bar in the middle (just as shown on Bait Spoon).

9h 10m This is below the lower end of the rapids - Itacutiara.

9h 57 - The wind is light - Our Canoe men take the shore or Canoe channel. The steamboat channel 200 ft to the left as we ascend is all right - and with a little more wind we would have sailed right up. As it is we pole - and at the first break our four poles got out and pulled - The water was shoal.

10h 10m At the second break they poled three boats touching - 10.35 - We sound crossing the channel obliquely 7-7-6½ 6.5 5 5 5 5 4½ 4½ 4 4 3½ 3½ 3½ channel.

11h Stop running a N.W. Course parallel and near the long bar - which on Halfeld's map closes with the Ilha for a long distance on Bahia side - but which has water between. Part of the bar to the right of the way we appears to close with the Ilha.

The Mouth - shown on the Paraibuco side on Halfeld's map - ½ mile above this long bar is merely the termination of a long ridge - elevation some 200 ft or 250 ft above the river - course about S.W. to N.E. Some points of rock

11.30 - Opp. W. pt. of the long bar. Considerable water apparent now behind it; but from the way the river flows it would shut all off. It is of no consequence. The Channel is good. Nothing is needed to be done

Soundings
11.53 - Strike lower end of rapids - 12 m. 14 m. 14. 15 - 16½

12.05 The wind being rather weak - We began Cordelling - 2 men out on the rocks in the water - Itacutiara Rapids

Use two Canoes. We could just about hold - but not go up - Our Current Measure gave 2.45 - with a good day - 2½ miles an hour.



Tuesday - 8 hrs 16.

breeze we could sail right up mid channel; which is very deep (as our soundings show) and wide 250 to 300 feet wide clear of rocks - A splendid steamer Channel.

After Cordelling a little while - we sail a little way from the Strongest Current with a mild breeze - The Channel in the middle at the least place is more than 3 Metres - our soundings on the Channel Shoal showed much more - Current strongest in Mid 4 miles an hour, but we were going about 2 miles an hour - We may be certain that the current is not over 4 miles an hour that any size or shape steamer can meet -

Above the first set of rapids is about ¼ mile of wide clear water of good depth - moderate current - from 8 to 11 metres when we saw. N. Halfeld's Map and soundings are very well.

12h 37 - Strike lower end of worst part of the rapids (200 metres)

12h 55m - We are fairly above the upper rapids of the Itacutiara One hour!

Our motion has been slight with the oars, and a very moderate breeze - although our four poles were used wherever they could. With a good breeze we could have sailed through easily.

On the upper Reefs, the Channel, in one place is narrowed to about 50 ft Clear of rocks - Impermanent rock - on the left. There is also a bank to the left in the Channel as we ascend. The strongest Current for a steamer to meet in Mid Channel will not exceed 5 miles an hour - Nothing is needed for steamers ascending - But for descending steamers it would be best to have some three points marked with stone columns set in the rocks, and to answer for a higher stage of water.

From appearances, there is a steamboat

Thursday Sept 16 Itacurina Road

Thursday Sept 16 Continuation of Itacurina Road

Tuesday Sept 16 (16) In Papogaia.

# CAMP Nº. 4.

## REPORT Nº 2 L.307.

There is already a good navigation without any work for ocean steamers from Sobradinho – where we encamped last night, to Papogaia – 4 Leagues.

In the rapids of Itacuiara, I would have marks at 3 rocks, in order to show the Channel for descending Steamers and to show it in a higher stage when those rocks are cover'd –

The current to be overcome will be from 3 to 5 miles an hour, with ample depth, and ample width 200 ft, or more excepting one place where it Crowded by rocks is about 40 to 50 – but any depth.

It is possible that the Channel towards the Bahia side may be better one than the one we examined – in certain stages of the River.

That point must be decided hereafter. I am well pleased with the result of the days examination.

W. M. R.

6.10 P.M – nearly dark –

## PAPOGAIA

Justinho Rock = Caraibeira or the name of a fish there

Our tents are pitched at the House of Sr Justinho. Our Cargum for the 12 animals has been brought from about a mile below.

I have concluded to go with the horses from here to Sorobabe while the Agoyos go around the pools to the same point



Wed. Sept. 17th We break Camp Nº 4. this morning

Mr. Derby, Mr. Sabroia and myself with Antonio for Cook and Manoel (of the Guard, who was with us on my other land trips,) and one other of the Guard, to be in my special party.

The Guard will also go – taking charge of the other six horses. –

My object in this arrangement is two fold: to see how matters work on the boats in my absence and to make an examination of the Pernambuco Branch for 2 leagues above Sorobabe – and perhaps further.

The "Melnora" and Anna Started at 8.40 – but the wind being aeap and not up, they went to the Bahia side and got aft – opp. about 8.40 – We then took breakfast (Sabroia, Derby and I) Antonio Manoel & Cook Start – with the Guard. Mr Derby rowed back to the 9.50 and rode slowly – a very hot morning. I sent a horse and rode slowly – a very hot morning. I sent a horse for a mule or two – then Mr Sabroia and Capt. Jorge Cassa the Chief of the Guard Came up. We rode on slowly till about 12.45 when stopped to wait for the Back Train –

By and bye, Mr. Derby Came, with his man. about 2½ P.M – very hot –

at 2. P.M. Ther. in Shade in the house 36° Centigrade = Fahrenheit 97° – In the Sun at 3. P.M it was 58° Centigrade = 133 Far. with sun.

our pack-train not coming, I sent a man back – on my horse, to see and help them if he could.

I then went to the River about ½ mile from the house camp a day camp of the 2nd which began in Com. Cook. a beautiful gravelly bank. I saw the Agoyos on the other Side, 2 miles up, at 4 P.M – They were a league above when I came on the Bahia side, going slowly – [La Colonel Train and boy Came along in a Canoe.]

River ¾ mile wide in floods – a little less now – Course for a mile or more here W. S. W.

at 5. P.M. The pack train Came. with one very one back horse, and one sick horse. Short 3 Leagues

Wed. Sept. 17th Papogaia to Sabuca

## 3d Visit to Sabuca.

This time, by Compulsion - on account of the delay of the pack train of 3 animals and the great heat of the day, and our late start, which was unavoidable, on account of the necessity of dividing the provisions and re-arranging the stowage in the Ajonjoy. We were up at 5. A.M.

[I think our ajonjoy will make 4½ or 5 leagues to day.]

I defer my report about Papogaia till I meet the ajonjoy party at Sorobabe - I hope to morrow evening.

Note - Sun Rise! to day, at 10 minutes to 6 o'clock, saw the finest Iris I ever saw - a full ring, with all the prismatic Colors - and all the space inside of the ring being decidedly darker shade than the clouds & heaven outside. The ring was very large - I should think about 200 diameters of the Suns diameter - It gradually disappears - evaporates, about 11 o'clock. It was within about 15 degrees of Zenith. The day then became very hot. Of course there was some moisture in the upper atmosphere to cause the ring; but not enough to indicate rain.

I can perceive daily a gradual increase in the warmth of the air, and in its dryness - enough to me most agreeably dry enough to cause suffering.

Meanwhile the river flows majestically and quietly by, with a current of 1½ to 2 miles an hour - 5/8 to a mile wide of grazing depth. Sounding of ample depth of Halfield's Map all along, on the Bahia side. I think there is also a good Channel on this side.

[no Camp - House.]

Sunset [say 18° North of West, at 5.58 P.M.



Wed. Sept. 17 - Sabuca.

Mem. As a rule, all the Rivers are overall & their (the dogs are still Mariner) they are active and enduring animals, because they have to. The food they get is more strong than grass and they don't get enough of that.

The men all wear Leather hats and leather Coats of a brownish red or reddish Brown - all cut after the same pattern - the hats made on a block. The Serandabarats usually have one long arm and often both. Shoes of home tanned leather and home made cut [illegible] should last ten years.

No wagons, or Carts, as a rule are used. We did meet 2 ox carts with solid, oval wheels the roughest of the vehicle kind I ever saw. The wheels may have approached circular when new. There may be some more of these now description.

Thur. Sept. 18th Sabuca to Sorobebe 2d Visit

We aroused the party at 3½ A.M. intending to make a very early start; but with much preliminary groping, before we left the House of the Widows, 6:20 A.M. had come. Then for an hour we were slipped finding half the time fording the Pack Mules at 7:30 before we were fairly underway - a Cargo of Mules out - We then forgot along well enough over the same track that we came out on the 4th of Sept - just 2 weeks ago -

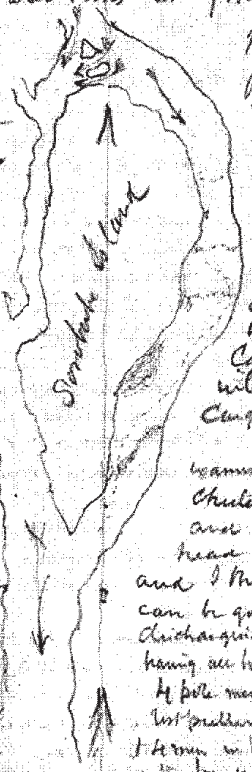
at 9:10 we pass the Pajaro Rivers dry. The same 2 little farms in the bottom of the valley - two years without water enough in it to stop fording except 1 day - Pajaro river has not been dry quite as long as the Mesquite.

at 9.30 - we are on the Red smooth plain

at 10.15 we arrive at Sorobebe.

We arrived at 10.15; but it was nearly 1 before we had dinner.

Immediately after dinner I went in a Canoe across to lower end of Sorobabe Island (which is about 2½ miles long) and then walked up along the Pernambuco side examining the Channels in order to ascertain whether we could have to unload Cargo in order to pass the Chutes in this Branch. This branch is wide 400, 500 1600 feet in places, and it has three rocky ledges across with little openings through which the water runs at present.




I noticed at the head of this Island, that a large volume of water nearly or quite equal to all that flows down the Branch below flows out from it, between Islands at the head, & runs over to the Bahia Channel and so flows lost to the Branch.

In ascending down low rocky ripids, with three or four low water steps to the Pernambuco Branch below the head of this island.

I was uncertain until to day which way the water runs at the head of Sorobabe Island; Halfeday's map shows the Island Channels very well, but it does not show which way the water runs in a low stage at the head of the islands.

The water has fallen considerably since I examined this Channel 2 weeks ago. It is probably 1 foot lower. It is now a question whether our Canoes can go up without unloading Cargo. I have to examined all the Chutes, grave bars and ledges to the head of the Island - and I think our Canoes can be gotten thro' without discharging Cargo - having all hands out except 4 Bolé men who are all the time pushing with the oars & poles in the water pulling on the boat.



Near 299 Leagues

It was excessively warm to day - I had my coat in a tree, and carried my white umbrella - I walked about 5 miles on the island, including some distance along the head towards the Bahia Channel - to see some of the volume of water passing out that way.

I am now quite confident, unless the water is to be within about 1 foot of a low stage - that a good Channel having 4 feet depth of water - say 400 ft. wide with a velocity not over 5 miles an hour can easily be secured by low rock rip dams - or low sill dams into Chutes - along the lower 3 miles of the Pernambuco Branch; and perhaps 50 feet wide 5 ft. deep without any great Cost.

=

A Channel 50 × 5 × 5 miles an hour = 440 ft. per min. = 100,000 Cubic ft. per min - or only 1/20 of the assumed low water flow.

There is now passing down this branch - say 200 × 3 × 2 miles an hour = 176 ft. 2 ft. = 281,600 c ft. per min. Supposing ½ of this should disappear at extreme low water with the water supply of the head of the island there could easily be secured through a Channel 100 ft. wide × 5 ft. 5 miles an hour.

But without some improvement - even Canoe navigation is almost destroyed in consequence of the water being scattered over a width of 3000 ft. many sand bars and Cargo - instead of being confined.

I must now see the upper Leagues of this branch, as in all probability this is the side for the steamboat navigation.

I returned to the foot of the island at 4 P.M. - and saw that the MAILNDRA with Sen Amarante &c - had just arrived. The ANNA came in not long after - and we all in camp now to night this is regular camp No 6 - The Boats have Camped at No 5 - Taperá do Cima near 302 Leagues

156 Thursday Evening Sept 18 — Sorobabe 2d visit

## Camp No 6

## REPORT No 3.

30¼ leagues to 299 L. = 8 Leagues
A good steamboat Channel all the way.

We are now approaching from below near the foot of the rapids Falls of the Cachoeira do Vão.

The 1st 2 Miles of the Branch that I reexamined this afternoon — entrance thro' mouth of the rapids, and will be a part of the improved navigation of the Pernambuco as shewn by soundings for the lower 3 miles of the improvement.

## Camp No 6

Friday — Sept 19 — 5½ A.M — awoke and dressed — Mr Derby Sabóia and I are to go up this morning about 7 miles to the Entrance upon of Rs. Cuité to examine the Branch (Pernambuco side) above when we examined before —

As usual when apparently ready, there is some detention —

6.15 Start — at 8.10 we cross a Salvia Stream — it is not flowing water now, but has beds of rock — which has a taste of Glauber Epsom Salts —

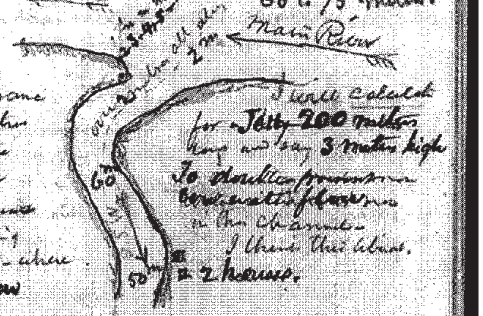
Salt is made here in a rude way — each inhabitant along the river manufacturing it suit himself —

At 9.15 — we arrive at the two Rivers within about ½ mile of these — Rs. Cuité and we are nearly to the upper Point — Here we breakfast — a good one

157 Friday Sept 19th — Head of Island Cuité.

We turned in about a mile back and found a nice clean Channel 150 to 200 ft. wide between Island & main — Clayey alluvia bank — fringed with Capim near the surface of the water and the Cattimary Growths at the slopes — Very favorable, indeed for a Steamboat Channel

After breakfast we cross over here where it is about 150 ft or 50 metres at the ellbow — but just above it is 200 to 250 ft wide or 60 to 75 metres. around the ellbow.




There is a good entrance of 100 ft width and 2 metres deep at this stage, and the Channel carried over 2 miles down to the houses — The mean depth here is about 7 0 ft of that depth — where there are some rocks under water

From the appearance of the river there is no difficulty in running from the mouth of this Pernambuco side Channel to the main Channel in the River say ½ mile to mile above Rodelles — afternoon examined & Mr Wilson Gibbons and found the large Church of the Missão at Rodelles to be in full view, about 2 miles off — a little down stream 1½ mile or more from where we are.

I went out in the Canoe with canoeboat, and a rowboat and also sounded down from the mouth to the houses full 5 miles — We finished about 11 a.m

Start back — notes down stream now —

Start back — At 11.40 a.m 12.05
1½ miles below head of Channel — in a Cachoeirinha Bear Island on Island side —
Keeps the other side closely
about five hundred to be heard

2 hours
in Early 26th
Sept (1)

158 Fri. Sept. 19th Examination of Cuiuté Id. Channel &
One Tenth mile below 12h 20m P.M. (in fact) and the 8 ends in 200
(2) face — gravel — clay & sand. 2500 & 3000 ft wide

12.25 1/8 mile below the gravel fall is a rocky
(3) obstruction 6 inches in 200 ft. Area 200 ft wide
Clear acc in 200 ft — 40 ft in the deep navigable part
2500 & 3000 ft wide Some Rocks to be blasted off 5 ft

4 12.33 A mass one 1/8 mile below — but a fair Channel
on island side for small steamers

12.38 6 small Islets — nearly like the first one — 18 inches face
(5) All 300 ft. The fourth channel to the island side
about 200 ft wide & 300 ft off main Channel 5000 ft

12.45 Enter end Cuiuté Island — Upper end of
Cabracan — Here the water flows from the
main River on the other side of Cuiuté island —
a Lake below — also Caimans in — also Cattle bridge
stage, on one of their watering places to run up & down the
islands — to flight — dam would remedy this

1.05 Another fall — where the main is 300 ft wide 1/2 M.
above the Cavallos falls — Rocky — Channel
nearest Main land 12 inches fall in 200 ft 5000 ft

There are rollers to be seen under water & under good rains
There is a good supply of water — but it must be Confined
5000 ft here

1.20 Cav do Porto Velho —

It is half a mile across where the
Large body of water comes in and below the
falls of the Island.

About 3 ft fall in 400 — There way to improve —
a low dam at the head 350 ft long and then a
Chute Channel wide 250 ft wide 300 ft long for a
good steamboat Channel There is water enough
Some rocks to be blasted. 20,000 ft —

Shot call this Porto Velho Fall, — Water Hunter thinks
1.40 Upper Falls 3 Islands Expenditure when Channel Cuts
in two Rondonia — rapid channel

159 Fri. Sept 19th Rx 2nd up Cuiuté Island Channel.
Sh is three or wide at this side Channel — The one on
Island is at least 1000 ft wide — Plenty of water
and a Channel — We will see this as we come up
the Rapids.

---

The general result of my examination of the Branch on the Pernambuco side is that it is entirely practicable to make it both a steamboat navigation in low water — say a Channel 3½ feet deep and 200 meters wide, with a velocity not over about 5 miles an hour. (say 9 Kil.

As nearly as I can ascertain, the water is now within about one foot, or say 9 inches of extreme low water, along these rapids.

Main water is reached on the branch from the head of the island Cuiuté down to the lower end, when it now becomes the water that runs below the island Cuiuté and Virava down Cabracan.

This water can be raised by building a dam or falls, and on the head of Cuiuté island to intercept 200 meters of the low water flow of the main river, and turn it into this Pernambuco Branch.

In addition to this, there are some minor Cachoeiras on the Branch which need trimming as to Canoes and guiding the water Cuiuté one Channel. [See Profiles on the Page 157-158]

In connecting out with the river opposite mouth of Cuiuté Island — with a Portage 8 ft long, of one meter each ft about 200 yds of the length. We Cannot say not yet know the depth there, but I am of the opinion that for the dam or falls of the Cuiuté 150 Metres long x 4 meters deep, + 2 inches wide it will be about = 1800 C. meters say 2000 C. M. at 20$ per Cubic mete = 40.000$000 with dam timber and Stone —

100.000 ft would make the Channel Pro —

160 Sept 20 – Saturday, Sorobabe, 2 visit

Soon after breakfast, and just after all of the Engineers except Sr. Sabrio and I, the mail man came with letters and papers for the Commissioners sent by Mr. Krüger, our mail man had delivered the mail we sent, but he has not made his appearance again –

Letters from Sr. Krüger, Col. James, and Mr. Roberts. Address letter referred to Letters from Milnor & Bain and Annie – dated Mr. Bozarth, and Circulars from Edwin M. Lewis, Director, and Receipt of Benedict & Co. for $3. Insurance receipt, also Americain Letter from Mr. Harrah enclosing my interesting Newspaper slips – One Concerning our interview with Capt. Eads quite important to me.

After reading the Letters and Newspaper slips, I proceed to write Letters to Addie – to Col. James – Capt. Eads – C. J. Harrah – Mr. M. Kennedale, Beecher & Benedict enclosing them my Check for $3. Mr. Roberts having the Receipt to fill, Letters them the Other, Cash bill. I wish to note here, that the Value of the Goods entered for $1500 is materially less presumably than that sworn, as many Kaos have been agreed since the first invoice when that sworn to Correct –

Also a Letter to Chief Engr. Krüger, in answer to his of the 17th ult. Sent to day – as follows –

1879

Sr Reinaldo Von Krüger Sorobabe, Sept 20 –

Dear Sir.

I am very much obliged by your kindness in sending your mail man with the mail matter of the Commissioners together with your Letter dated 17. Sept.; for which please accept the Regards of all of us.

I note the Contents of your Letter, and I hope you will arrive at a satisfactory understanding with

Sept 20. Sat. Sorobabe 2 Visit 161

the Government respecting the Launch.

The only thing that seems to call for advice or Suggestion from me, in the above Connection, relates to the Fireman.

Not having employed him or authorized his employment, I am somewhat at a loss what to advise. I suppose that Sr. Rodrigues thought he was doing right when he engaged them.

I would suggest that the Fireman's wages be paid from the day he was engaged till the day of his discharge; that as soon as you find that there is nothing else for him to do. If you think it proper to allow him time and to pay his passage back to Penedo, I would not object to that.

Under the Circumstances, I think it is better to adopt your suggestion of engaging two men to act as Couriers between Sorobabe and the Commissioners. One man will go down with your Convoy in time to start back on Wednesday or Thursday next with mail, the other to leave us, as circumstances may be, in time for the mail of the following week.

We may perhaps leave here tomorrow, with our escort, but we do not expect to get further than Rodelles, the day we leave here.

With kindest regards for yourself and your staff I have the honor to be

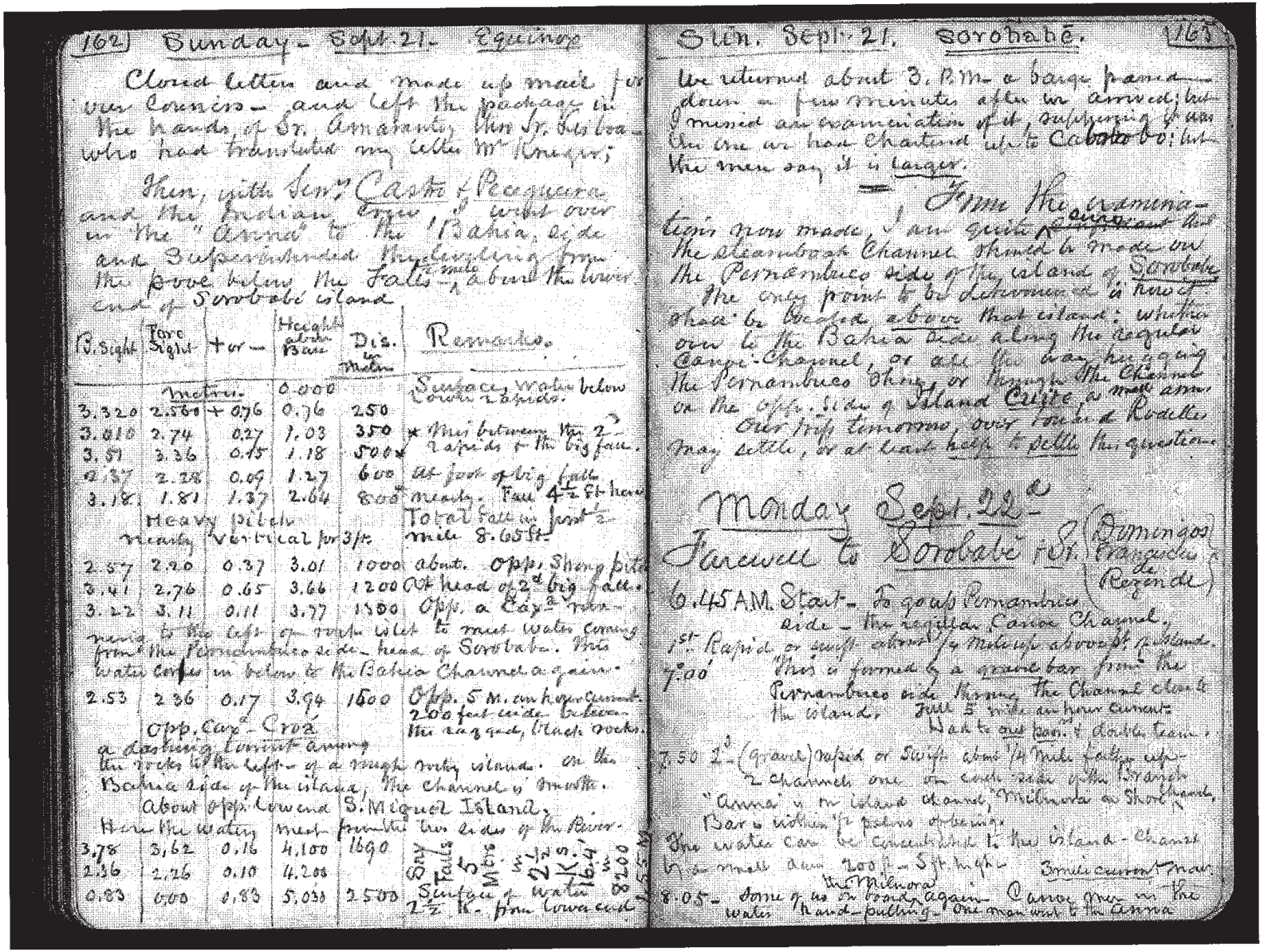
Yours truly

M. M. Roberts

Engineer in Chief

P. S. The mail will send with the mail in Company with your mail man, as to be at your Command during his stay in Piranhas.

The engineers who have been engaged on the Bahia side, surveying Levels, and Transit &c, having made favorable report of Conciliador. This I will go over myself, again, tomorrow, and verify, and get a better idea of the falls, Rapids and Rapids.



162 Sunday - Sept. 21. Equinox

Closed letters and made up mail for various Consuls - and left the packages in the hands of Sr. Amaranto, Chefe Sr. Cabral who had translated my letter Mr Consignor;

Then, with Senr. Castro & Pereira and the Indian Crew I went over in the "Anna" to the "Bahia, beside and Subsequently Mr. Cleveland from the Povoa below the Falls - about the lower end of Sorobabé island

| P. Sight | Tare Sight | + or - | Height above Barra | Dis. in Metres | Remarks. |
|---|---|---|---|---|---|
| | Metres. | | 0.000 | | Surface of water below Lower Rapids. |
| 3.320 | 2.580 | + 0.76 | 0.76 | 250 | |
| 3.010 | 2.74 | 0.27 | 1.03 | 350 | * Mid between Nos 2 Rapids & the big fall. |
| 3.51 | 3.36 | 0.15 | 1.18 | 500 * | |
| 3.37 | 2.28 | 0.09 | 1.27 | 600 | At foot of big falls |
| 3.18 | 1.81 | 1.37 | 2.64 | 800 * | nearly. Fall 4½ ft here |
| | Heavy pitch nearly | | Vertical for 3/4 | | Total fall in first ½ mile 8.65 ft. |
| 2.57 | 2.20 | 0.37 | 3.01 | 1000 | about. Opp. Sharp pitch |
| 3.41 | 2.76 | 0.65 | 3.66 | 1200 | At head of 2d big fall. |
| 3.22 | 3.11 | 0.11 | 3.77 | 1300 | Opp. a Cap.a rock - |
| | | | | | rama to the left on rocks left to main Water coming from the Pernambuco side - head of Sorobabé. This |
| | | | | | water comes in below & the Bahia Channel again. |
| 2.53 | 2.36 | 0.17 | 3.94 | 1600 | Opp. S M. on h.per Current. 200 feet wide between |
| | Opp. Cap.a Cruz | | | | the rapids, black rocks, |
| | a dashing current among | | | | the rocks to the left - of a rough rocky island. on the |
| | Bahia side of the island, the Channel is smooth. | | | | |
| | About Opp. Cap.a Cruz end | | | | S. Miguel Island, |
| | Here the water | | meets | | from the two sides of the River. |
| 3.78 | 3.62 | 0.16 | 4.100 | 1690 | |
| 2.36 | 2.26 | 0.10 | 4.200 | | |
| 0.83 | 0.00 | 0.83 | 5.030 | 2500 | Surface of water 2½ K. from Lower end |

Sun. Sept. 21. Sorobabé. 163

We returned about 3. P.M. a barge passed down a few minutes after we arrived; but I missed an examination of it, supposing it was one we had chartered up to Cabaceira but the men say it is larger.

Time the examination was made, I am quite uncertain but the steamboat Channel should be made on the Pernambuco side of the island of Sorobabé. The only point to be determined is how it should be located above that island: whether over to the Bahia side along the regular Canoe-Channel, or all the way keeping the Pernambuco shore or through the Channel on the opp.te side of Island Cuiré a small one. Over first tomorrow, over rocks & Rapids may settle, or at least help to settle the question.

Monday Sept. 22d (Domingo) (Segunda de Regende)

Farewell to Sorobabé Fr. St. Francisco

6.45 A.M. Start - To go up Pernambuco side - the regular Canoe Channel.

1st Rapid or swift about ¼ Mile high above S.t Island.

7.00 "This is formed by a square bar from the Pernambuco side strong. The Channel close to the Islands. Full 5 mile an hour current. Had to out Pass.rs & double team.

7.50 2d - (Grand) rapid or Swift about ¼ Mile Long up - 2 Channels one on each side of the Island "Anna" in Island channel, "Milnora" on Shore Channel. Bar a million fragments of being.

The water can be Concentrated to 1. New Island - Channel 100 meters Abm 200 ft - 5 ft. high - 3 mile current - now the "Milnora"

8.05 - Done pass on board again - Canoe gone on the water Hand-pulling - One man with the Anna

Mon., Sept. 22 - Along Sandalo Channel.
We have 5 persons on board today — we have 5 persons on board.
(Cassiopeia)
11.08 anchor, mud & sand bottom, 4 fathoms.
Sandalo Channel, middle part.
The island Pedro; mouth of Sandalo Channel.
Sandalo Channel, 300 ft. wide.
Sandalo Channel, Cayo Norte, 20 ft.
Sandalo Channel and Victoria Pool Sec. of Ruins here yesterday — or the day before.
11.30 - Must see a few more in the morning before we which have not already seen.
11.37 Rapids. 2 stations & marks made - 100 ft. apart. Some very rocky & a few dangerous to continue the water - Must make about 200 ft. longer the island 60 ft. wide - Must be big ship. Good Looking down in Pedro big ship.
11.40 - Stop. The West channel from the shore of Sandalo Islands, a channel 300 ft. wide, very rocky & dangerous. Another channel from the Pedro Islands. The islands are mostly sand. Another channel from the Pedro side. The islands are mostly sand. Stop the vessel in the middle of the channel.
11.55 Must have a bad place in the channel - which about 10 or 12 ft. with very fine & coral rocks, very near to them with very near to be dangerous. Channel with very near to be dangerous. Must go slow & careful. Must go slow & careful.
12.05 - We are now running thru the Channel between S. Cristina and the Pedro Islands (Sandalo) Cayo S. Maria and Pedro Islands - (To avoid the Cayo de Espada shoals along the Pedro side.) 12.20 P.M. Stop the vessel. Must have a channel to the Pedro Islands. Must have a channel to the Pedro Islands. Must have a channel to the Pedro Islands.
12.27 Lose sight of the inside channel between S. Cristina and Pedro Islands.

(Mon. Sept 22) San Miguel - Island. & S. Antonio Is.

12.40 at Point of Island Boys - little island between San Antonio and San Miguel.

12.50 Main channel 300 to 500 ft. wide - much obstructed with rocks & small shoals - a strong volume of water flows down here and on to the Bahia side which is indicated by clamoring canoe channel to the Pernambuco side.

1.03 - now we have turned to the right, up a steep reach between the small Island Pão Gaco & S. Antonio - we used the cord to make the passage - 10 ft all the way.

1.07 - In an 80 ft channel - with little patches.

1.15 - A hard pitch - 3 fathoms - we took the smallest - and with a cord & double team we just squeezed up - all hands on shore in the rocks also.

1.23 - all the boats are up at the head of S. S. Antonio - where a channel runs off between S. Rosenda & S. Antonio - the water going to the Pernambuco side.

Sandy shoal of 300 ft & patches 30 ft. more canoe turn the water over to the Pernambuco Channel that we now use.

Canoe - Came from Rodelles - Takes Mr. Amaral, wife & sick and Mrs Peregrina - to Rodelles.

1.45 Start

Shoal up a patch, with cord -

1.58 Opp. upper end of S. Miguel - Channel across to the Island Jacuruba - 138 metres - measured and sounded by Mr. Meiser and Leibria:

Depth 4 metres - Current moderate - Water runs over to the Bahia side.

If this work should be necessary to take a long many, that side of the above location where it is shallow - say 700 ft long 6 ft. high it is a large volume of water.

The river is here full ½ mile wide - the regular channel running from Rodelles across to our right, to the main land Pernambuco side.

Sandy Mangs - shows thus my work.

2.10 Use hoist sail - wind moderate - fitful.

2.22 Opp. lower pt of Cabaceo Island - River nearly half mile wide, deep, slight current.

(Mon - Sept 22) The main channel goes 167

which comes over from Rodelles, now in the regular looking Channel which is nearer to the island Jacuruba. We are near the Island Jacuruba. From here it seems obviously over to the Pernambuco shore deep and wide - to where Mr. Meiser & Leibia began their soundings the other day - It is a good steamboat channel back from here to the Pernambuco side - for steamer drawing 9 metres or something more -

This wide channel does not admit of material change without considerable Cost; but if it holds as good as here, to the Bahia side, it will do.

2.40 We leave the main channel and go off to the right among small islands, where there is only a canoe channel -

The reason assigned by the Pilot that the main Channel is too deep.

I will have to see this main Channel either this evening or tomorrow morning.

3.05 Between the Little Island Cabaceo and the island Tucum - in the main channel, but on the Canoe - line side of it - There is a good steamboat navigation from here back to the Pernambuco side.

3.20 We are poling our way in and out in the canoe channel among the rocky islets - with occasional little shoals - the main channel being over to the left - with deep water - up to near the Cap. Rio do Otho.

3.43 - We have just worked up through one of the hardest patches we have had. The main channel is now off to our right, the pilot says it is deep, and it has that appearance, and Malfield's soundings show for nothing less than 9 ft. in the Channel - South Main now toward the islands Uruba.

4.10 We are now in or near the deepened channel shown on Malfield's map, within half a mile of the Island Otho - to the left - on a direct course from this point.

Mon. Sept. 22 In the main River now. Rocks, Rocks!

158 4.12 - The water comes down on the left side of Island do Pinga and turns and runs up above, and we actually descend down up above, through a small Chute in the Canoe Channel

4.23. We pass up a small rocky Chute - without trouble.

4.32 Now sailing among the rocks - about to anni at Rodelles - town just ahead;

5.05 Arrive at Upper end of the Village of

## The Missão João Bapta de Rodellas.

League 297.

The name town and seems much more im-portant than the Village betokens; although it has two Churches; but no Padre.

It is nothing more than a Village of Caboc-mon and their families. No Stores or business house here. Our landing place and encampment is readily observed at the head of Ilha da Porta.

We are now almost directly opposite the head of the Island of Cuiú Cuiú where I was on Friday Sept. 19th with Co, Brito Jr. Saboia, and Mr Derby.

Here we have a river nearly two miles wide, dotted with little islets some of them grown with a sort of willow growth, all of them rocky, and many of them must have rocks

Our boats are piloted under a peculiar looking tree, called the Quiravabeira Its compound of many trunks combined - the whole making a mass about 7 feet in diameter. The tree has handsome foliage - though the leaves are quite small

## Report N° 4

Respecting the Channel for a Steamboat of light draught, between Rodellas (or this part of the river) and the Lower end of the Cabeady of Bom Babe - from whence we came to day, am satisfied that it can be made in two ways; One way down the Pernambuco Branch, which

Mon - Sept. 22d Rodelles - Evening. 169

I commenced on the 17th (and as found before) the other way by following the general route indicated by the Sandoja as far as they are given on Halfeld's map, and then down the Pernambuco Branch - Supposing them correct.

These are to be studied and Calculated hereafter. I have merely made such observation and taken such notes as will enable me to study and compare, and decide, after I shall have become acquainted with other parts of the river above here.

I make no decision of route, or dimensions or estimate of cost at present.

Report N° 4 -

Therefore I say, that a light-draught steamboat navigation thro these 1st mile - 2/3 leagues - (being Leagues 298 - 299 Cabeadas 297) Can be made. The Cost will depend upon the depth which is to be guaranteed for between Low water.

After my experience about those Falls and rapids, I gave up the idea of ever completing a Report to inform the Bahia Public, because either of the other routes can be made more feasible, and will be much more useful. The objection to informing the Bahia side, are, that the distance is much shorter, reducing a much steeper slope, and the cost of transforming that part of the river into an ascending steamer navigation would be very much greater than either of the other routes.

I will not say that, if the other routes did not exist, that it is impracticable to make an ascending steamer navigation all the way on the Bahia; but, owing to its characteristics, the Cost would be very great; and the same steamer that could ascend on the other routes, could not ascend on the Bahia side. The steamer would have to be more powerful and consequently heavier, more costly to build and more expensive to run.

The details of the results of our examination of these 2 1/3 leagues, cannot be made up, as we have formed our Report of the River

# Rodelles.

After making inquiries of the pilots and Canoe men who live here, concerning the Channels, I have decided to remain here to day, and examine two.

Messrs Nevin & Shiva will examine the one farthest out from the Bahia side, and also take soundings from the Point S. of the island Cuite out to the main Channel; while I with others examine the one nearest to the Bahia side. One passes on the other side, and the inner one on this side of the great rock Urubu - which frowns in front of the village of Rodelles, [sketch] Island. Begin about 1 Mile above the Church near middle of Town. 6.38 about ½ P. about Ia Cuite

## Soundings - in Metres.

6 feet sounding.

Mr Darby left the Record of the Soundings which were taken from yacht & Canoe to gather all the way.

A.M.

9.44 - 2 Rocks to right & good wide Channel ½ M. deep
Channel curves to right.
9.45 1 Rock on each side 50 ft. between 1½ M. deep bottom
Nice curve to right. now 2 miles
9.48 - Church of town above with a few small white houses 1½ M. depth in Town. a few rocks to be marked
9.50 Tangent - Then curves gently to Cuipa. 1½ to 2½ M
Channel clean 60 ft or more - 80 ft
9.51 Curves again to right to 9.52 Rock both sides
9.53 Rocks both sides. 50 ft. 2 feet to ½ M.
Now a nice curve to Cuipa. 1½ M. ½ M. ½ M
9.54 ½ ½ good ½ M
9.55 Church - Opp. town - 1½ - 1¼ - 1½ ft
Then curves to left 1. 1½
Running over towards island. Porka 1½
9.56 Now town curves to right - 1½ to 2 M.
Now steering towards low timbered town Santarem
9.57 about 0 ft. Church - Singular, gently to right 1½ ft
9.58 Smoother gentle Church Cuipa clear 1½ to 1¾ ft
10.0 off Nice Opp. Santarem - 2 Metres.



Hatfield's Channel.

Now, turn to left towards Middle - 2 Metre Channel and on
10.01 2 to 2½ M. nearly out to middle - wide 100 ft
10.02 50 ft clear & rock - 1½ to 2 M.
Some rocks to be marked. Island ahead
10.03 - Wide, clear - 2 Metres 1¾ 1½ M.
10.05 " " " 1¾ 1½ M.
10.06 " " 2½ 6 8 M.
10.07 within 300 ft of Bahia shore
10.08 2 Rocks to be marked - 100 ft to 250 ft from shore
10.08½ Wide - clear - 2½ M.
10.10 - Narrow 1 M. wide. 50 ft - Some hills with low - 1 & 2 M.
10.11 Narrow - 1 & 2 M.
10.11½ Narrow curve to Left to Church
10.12 In Church 2 M - 1¾ 1½ - 2¾
Hard turn to Left - over hard towards left of Porka Island - 1 M 1½ 1, 2 - 2 M left
10.14 Range Church 1 mile ahead to Town exit
10.15 ditto ditto 1, 1 - 1½ 2 width 200 ft
1 Island. 1½ 1 - 1
10.16 100 ft from island - 1 1½ gently fair 1 M -
10.17 In that reach Cuipa - front of Island
10.18 - Narrow 30 ft. 1½ Mud 6 ft - 1 M out -
10.20 - 1 mile to Cuipa - light wind
10.21 - Side curves - making for bahia side 1¾ M
10.22 Good, wide clear 1¾ M
Town 1 mile ahead -
10.23 Good wide 2½ - 3 -
10.26 " " 3½ 4 M - 3 - 2¾ 150 ft, or more
10.27 " " 2½ Rocks on left 100 ft clear
10.28 " " 3 - 3½ - 3½ 4 - 4½
All the time widen to Left a only more
10.29 Good, wide clear 4½ - 4 - 3, 3 2½
10.30 " " " 2
10.30½ narrow 1 M 20 ft - Church ahead 2½
10 31½ 100 ft. 3½ 4½ ½ - diff - Good.
10 32 30 ft - 3 - 3
10 32½ Wide, clear 2 - 3½ M. turn to left -
10 33 " " 2 ½ M
Approaching Cuipa

(172) Tuesday Sept 23. Sounding - Halfitch's Channel.

10.33 - Soft - 2¾ - 3¼
34 Soft 2½ same chart - 3 - 4
34½ Chart Soft deep. 36 fm. Good
Hard Point in Chart - rocky - Mr. Meiers Narrow - Cabral a Channel in Canoe
10.36 Under a Bottom, wider Channel
10.37 - Below Chart - 8 metres deep then 5 metres
10.38 - In wide deep Channel - 6 to 7 Mts.
10.41 - Wide clear - 11 metres - 12½
Island (Broke on night - 14 Mts 5.
10.45 - Soft Off. town and Island Pacuiba.
10.47 - In port 2 m. Off. Upon Pacuiba Island
Good navigation -
Approaching small Chart along Pacuiba Island
2 - 1¾ - 1¾ - 3. 2¾
10.49 Chart - 2¾ - 2½ (Good wide) 2¾ - 2½ - 2½
10.50 Below Chart 3 Soft - 5, 4 (good) 3¾
Approaching another Little Chart 3½
10.50½ Chart - 3 - 3¾ in chart (good wide) 3¾
10.51 Below Chart 3¾ - 3¾ 5 - in port below.
10.55 Narrow are - the main Channel 3½
Stop - Pass navigation on to the
[Trip Watch 3 Minutes Slow] Mr. Dewey
We stop. Off. quite a large town on Island - white
dark Colored people - some.

Upon the whole the Channel we have
Sounded is better than I had looked for
Although there are a few hard points
in it. But a moderate dredging would seem to make
it a clear 1 metre navigation.
Rest - 18 minutes

11.11 - Start back - men unshipped

1.35 Arrive at Camp No 7. [We met the
"Annie" going down the other Channel...

Tuesday - Sept. 23 - Roaellas. 173

Evening - Camp No 7.

Report of Mr. Meiers (carried by Sr. Lisboa) of the Channel navigable of the other Channel East of the Island Big Rock Urubú - and of the Shoal ridge off the North point of the Cuiti Island - at the inlet of the Pernambuco Branch of the river.

Messrs. Meiers & Lisboa have just come back in the "Angra" (4 P.M.) having been out in Channel from the Jaime Ponta (or Near Island) that we started from this morning to the main deep Channel at the Jacarésa - about where we stopped our soundings. They find a Channel every where more than 2 metres deep at this edge of the river, and most of the way over 2½ metres. There are only two places less than 2 metres and no where less than 1½ metres; and the Capt. & Engineer the two places are 1½ the other 1½ metres & 2 metres depth with a quite trifling rise over a few hundred metres.

We are therefore sure of a Channel without any work with above 1½ metres deep from the deep pool above Rodellas & the Pernambuco Channel at the Island Jacarésa 1½ metres, or I may say 2 metres deep, with an insignificant Canal & Exploration; but I would advise a few Hours and Meiers to make the Channel straighter and safer.

Accordingly I no longer consider the Pernambuco Channel along the Island Cuiti necessary to make a fair steamboat navigation.

The actual opening will be between the lower end of the island Jacarésa and the last Chart (above the lower end of Sorobaby) 1½ League or say 3¾ miles 6 Kilometers. See page 174½

174 Tuesday. Sept.r 23. Camp N.o 7– Rodellas

Memorandum:

After examineing the Halfeld Map Channel, from a point about a mile above the Serreiary to the wide, clear, deep Channel along the head of the Island of Jacuricibe– where it strikes the Channel along the Pernambuco side, I am enabled to say,– that at this present stage of the river (said to be within a palms, or within 8½ inches of its extreme lowest stage) very little Labor comparatively, is needed to make a steamboat navigation– say for a steamboat 100 ft. long, 20 feet wide drawing 3 feet. I ended with the pilot– (Leivas) whom we had to day, with such a steamer up, now; but, in order to run her down safely, some Rocks would be removed or marked.

But, if I were required to insure a depth of 1½ metres, or say 5 ft.– draught at extreme low water, the Cost would be considerable; because numerous rocks that are now a metre below the surface would have to be removed; probably, in most cases, by blasting.

Page 174½ of this Field Book,

The expense will be chiefly the Construction of low-water dams, to prevent the waste of water from the Pernambuco Channel over towards the Bahia side.

The chief of these is between the islands Jacuruba (forward) and the stepper point of the Island San Miguel; between San Antonio and Island da Ordenara, (or across to the small intervening islands) in order to prevent the waste of water from the Pernambuco over to the Bahia side and the Training of the Pernambuco Channel, at the Cachoeiras, and little rapids, as noted in my Journal of examinations of that Channel. See Journal of Sept.r 22.d– and of Sept.r 3.

I am very greatly pleased with the results

Tuesday– Sept.r 23.d– Camp No 7 Rodellas 175

Evening–

Of our examinations of these 7 miles! I am now sure that with one steam's Mysoa– tens, and another steam's work, I can make a navigation 7½ metres deep that steamboats can pass safely up and down between the lower end of the Island Sorobabe and Rodellas – 2⅓ Leagues = 7 miles or about 11½ Kilometers– for not exceeding 250:000$000. to 300:000$000

REVISE

I consider that I have now reports from Jatoba to Rodellas = 17+ leagues– 57 miles. What rough approximate of Cost for a 1½ metre navigation on these 17+ leagues 250:000$000– to 300:000$000

Lt. H. C.–

REVISE Evening Sept.r 23.d 1879–

We are to start with the 4 pinnaces "Melnea" and "Anna" & "Melnea" & "Oca" at 6. a M. Tomorrow.

☞ SEE VOL. 2.d

Roll of Names — Sept. 7th 1879
11 o'clock, Tents Camp Ground, Mt. Vernon
Mt. Vernon Rebekah Assembly

S. W. Roberts
W. M. Landes
M. L. Roberts
S. C. Hays
Rev. G. Monbrae
Geo. E. Beach
Capt. Wilkerson
Wm. A. Billings
Wm. H. H. Coleman
Geo. G. McCollum
Geo. Ragan
Wm. Roberts
Capt. J. B. Lacey
E. S. Elliott and Lady
Col. Jasper Parrish
E. K. Hunter and Family
Chas. J. Richard
* Col. Chas. McClure
* Wm. M. McClure

Mrs. Mrs. Walk Came &c.

Mrs. J. V. Mason
Mrs. Gen. J. Coles
Gen. C. C. Pearce
" J. N. Macomb
" G. Wright Reif
" Thos. J. Harden
" Thos. C. Cozad
Dea Cath. Rudisill
Dr. Wm. Clapp
Grandson
Eldest Miss Lacey

Capt. Wm. McClure Co. D. 5. A. Bonn
Captain Co. K, 1st Regt
Lieutenant, 1st Regiment
Sergt. 1st Regt

251.52
21.18 *
230.34 Mc

Wm. Walker pays Jackson 68.00
Donation 5.00
6.25 1/2

$21.11
6.25
15.7 1/2 Mr. Allison

Captain Stratton - Yolet - Rep. 219 - Sail

The main arrows of the Rio de São Francisco in the Eastern province of the Minas Geraes, between St. Lat. 20° 50' and W. Long. 3° W. of Rio de Janeiro).

St. Hilaire going to the Serra de Santa Catharina 607

feet of altitude. Wales West & East. 35° Leagues

to make mountainous Country. Before reaching the

Morro grande branch 140°. Mag. depth 3, 2 p.m. Anchorage

150 cable moles per accord.= 7800 E. Pt. Pan Mount

Sweden to Plan from S.A N. Serra Branca or Coffee

Race on the E. and 100 mile Ca Cordes formerly the

Vic. coast.

Parantiba to Pernambuco Soundings & nothing

Port V. Plan E. dark. Hope geographies (226)

645 metres = 1440 miles

Pirapetinga to the Cachoeira de Sobradinho-239

to 240 leagues ready for observation - most unbought

the Rio das Velhas affords 1st 5 leagues can be

made practicable with little difficulty.

Below the Sobradinho 29 down leagues, performed by

244 Capt. Mouth dangerous, are Remedios

to Cafe and Canoes.

From Varzea Redonda 25 to 26 leagues are unpractic-

able - including the Great Rapids of Paulo Affonso

Again below the line of Rapids 42 leagues, upon

which Steamers may ply, the Amparo dos Pavoes

dos Sangradeiros de Grande carriage to the São

Francisco the 4th rank ammunition the steamer of S.

Commerce - Comarca Sabará Kilometers = 3345 miles

Paracatú - Place 3440 2133 "

Vet Capitania 2360 " 1466 "

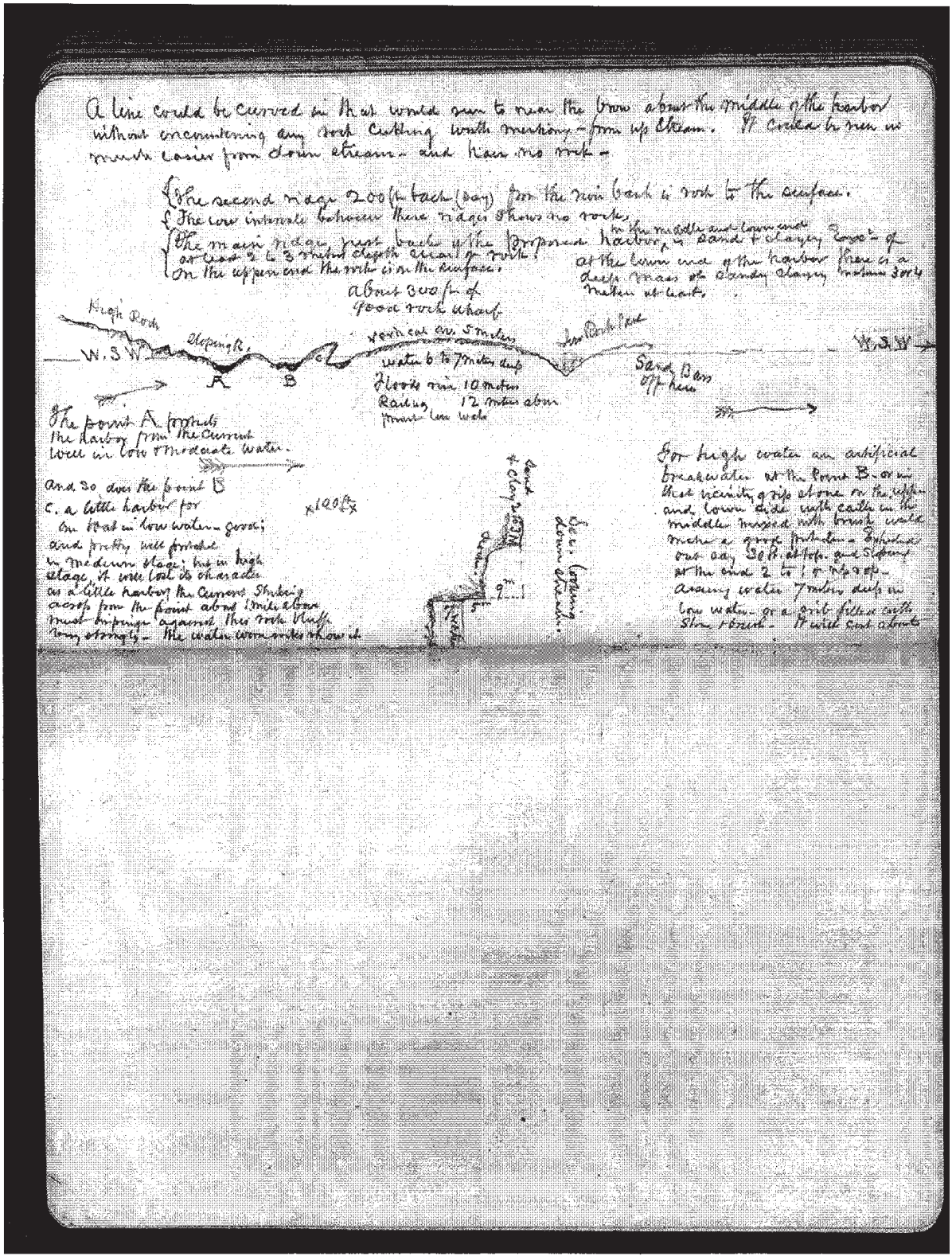
* São Francisco 2100 * = 1302 Eng. miles

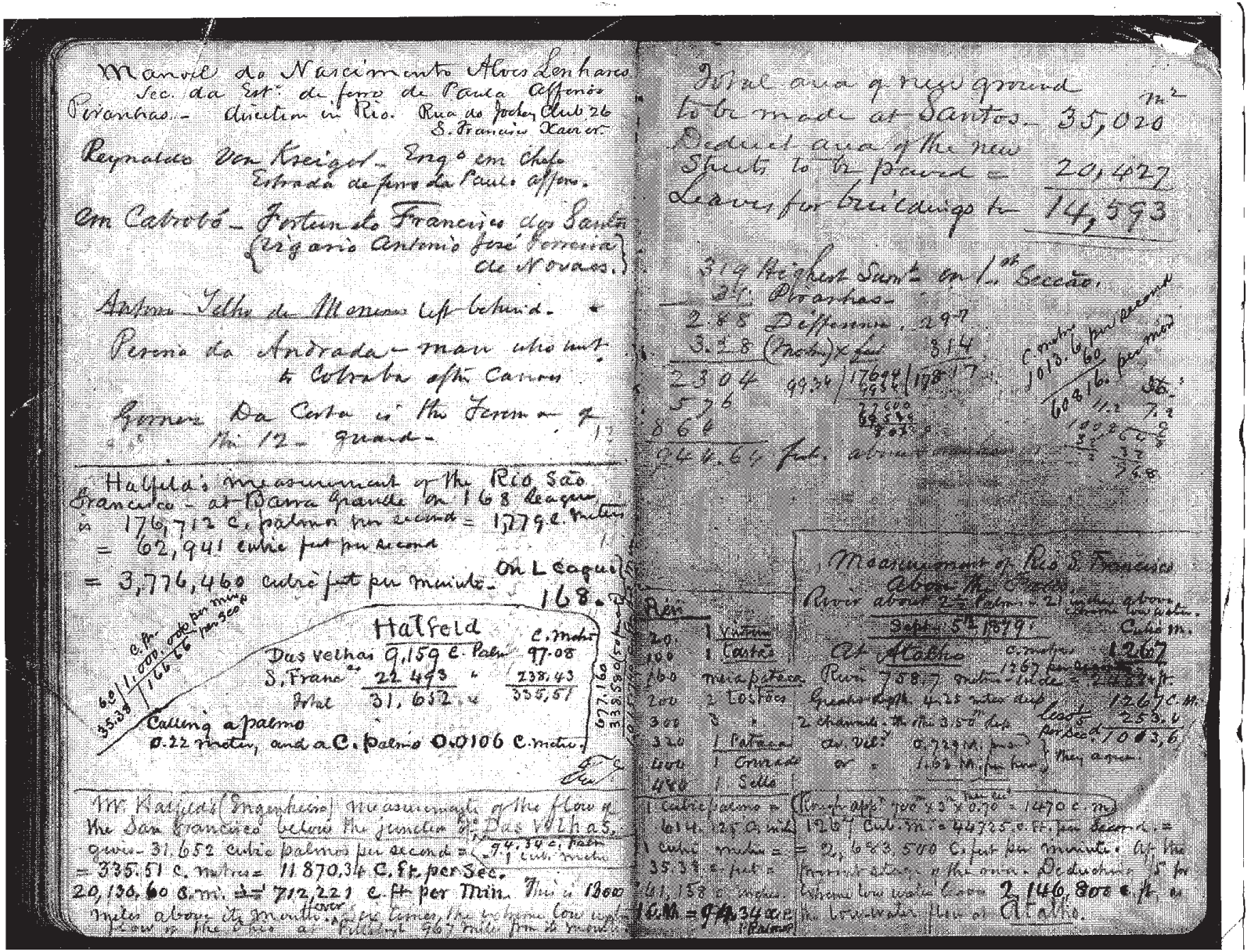
Rio das Velhas - Source in Mountains of Rio das Velhas

800 Kilometers Mouth in the São Francisco 2000 Kil.

miles = 175 & English miles.

Commander 17 or 18.


A line could be carried in that would scarce be seen to near the brow about the middle of the harbor without encountering any rock Cutting with marking - from up stream. It could be run in much easier from down stream and has no rock -
The second ridge 200 ft back (say) from the rock bank is rock to the surface.
The low intervals between these ridges show no rock,
The main ridge just back of the proposed Harbor, is sand & clayey loose - of at least 2 & 3 meters depth over rock!
On the upper end the rock is on the surface.
In the middle and lower ends of the harbor is sand & clayey loose -
At the lower end of the harbor there is a deep mass of sandy clayey matter 30 to 40 meters or more.
About 300 ft of good rock wharf
High Rock
Sleeping R.
W. 3 W
A
B
C
Low Rock Point
W. 3 W
Sand Bar Off here
Water 6 to 7 meters deep
Floods rise 10 meters
Rising 12 meters above present low water
The point A protects the harbor from the Current well in low & moderate water.
And so does the point B
C. a little harbor for
One boat in low water - good;
and pretty well protected in medium stage; but in high stage it will lost its character as a little harbor; the Current striking across from the point about 1 mile above must be pring against this rock bluff very strongly - The water worn rocks show it
Sand & clay
Rock
For high water an artificial breakwater at the point B - or in that vicinity of rip stone on the upper and lower side with cable in the middle mixed with brush would make a good protection - Depth of one day 20 ft at top - good slope at the end 2 to 1 or 3 to 1 -
Average water 7 meters deep in low water - or a crib filled with stone - It will cost about



Manoel do Nascimento Alves Lenharo
Sec. da Est. de ferro de Paula Affonso
Piranhas - direction in Rio. Rua do Jockey Club 26
S. Francisco Xavier

Reynaldo Von Kreiger - Engº em Chefe
Estrada de ferro da Paula Affonso.

Am Cabrobó - Fortunato Francisco dos Santos
(Engenio Antonio José Ferreira
de Novaes.)

Antonio Telles de Menezes left behind.

Pereira da Andrada - man who went
to Cabrobó after Carvalho

Ignacio Da Costa in the Ferry q
No 12 - guard -

Halfeld's measurement of the Rio São
Francisco - at Barra Grande on 168 leagues
= 176,712 c. palmos per second = 1,279 c. metres
= 62,941 cubic feet per second
= 3,776,460 cubic feet per minute. On Lagoa 168.

Halfeld
Das velhas 9,159 c. Palm — 97.08
S. Francº 22.493 " — 238.43
Mist 31,652 " — 335.51

Calling a palmo
0.22 metres, and a C. palmo 0.0106 C. metre.

Mr. Kaiffer (Engenheiro) measurements of the flow of
the San Francisco below the junction of Das Velhas,
gave - 31.652 cubic palmos per second = 94.34 c. palm
= 335.51 c. metres = 11 870.34 C. ft. per Sec.
20,130.60 C. m. = 712,221 c. ft per Min. This is 1800
miles above its mouth. [illegible] per cent. the volume [illegible]
flow of the river at Pirapora 967 miles from its mouth.

Total area of rugs ground to be made at Santos - 35,020
Reduced area of the new sheets to be paved - 20,427
Leaves for breidego to - 14,593

319 Reichert Sumé on 1st Secção.
24 Piranhas -
288 Delfosse. 297
3.38 (Packy) x gas 314
2304 99.34 | 17694 | 178 17
576 9954
864 27600
65 580
9 07 8

Measurement of Rio S. Francisco
Above Mr. Conrado's
River about 2 1/2 Palmos = 21 inches above
Sept. 5th 1879. Cubic m.
Cº Atalho c. metres 1267
Rain 7 58/7 metres - Width = 1267 per second = 2146 80 c. ft.
Greatest depth 4.25 metres deep 1267 c. m.
2 channels - the one 3.50 m deep least 253.4
Cº Velº c. 729 M. per sec. per sec'd 7 0 3,6
or " 1.02 M. per sec. they agree.

1 Cubic palmo = 0.0106 C. metre (Conrado's "720" x 3 x 0.70 = 1470 c. m)
614.125 C. mts = 1267 Cub. m. = 44725 c. ft. per second =
1 Cubic metre = = 2,683,500 C. feet per minute. Of the
35.33 c. feet = [illegible] Deduction 5% for
1 61.158 C. metres [illegible] the Conrado flow of Atalho.
1 C.M. = 94.34 x.c
1 Palmo

E-BOOK

**COMISSÃO HIDRÁULICA DO IMPÉRIO:**
**CADERNETAS DE VIAGEM**
**DE MILNOR ROBERTS (1979)**
VOLUME 1

Este livro foi composto no formato 21,0X29,7cm,
fonte Minion Pro (texto principal e títulos).
Em novembro de 2026.

WILLIAM MILNOR ROBERTS DEDICOU SUA VIDA AO DESENVOLVIMENTO DA ENGENHARIA NOS ESTADOS UNIDOS E NO BRASIL. ROBERTS NASCEU NA FILADÉLFIA, PENSILVÂNIA, EM 1810, FILHO DE THOMAS PASCHALL E MARY LOUISE ROBERTS. CASOU-SE DUAS VEZES: O PRIMEIRO CASAMENTO FOI EM 1837, COM ANNIE GIBSON, DA PENSILVÂNIA, COM QUEM TEVE SEIS FILHOS; DEPOIS SE CASOU COM ADELINE DEBEELEN, DE PITSBURG, COM A QUAL TEVE QUATRO FILHOS. SUA EDUCAÇÃO FOI NA FILADÉLFIA EM ESCOLAS PARTICULARES. TAMBÉM FEZ CURSO DE DESENHO ARQUITETÔNICO NA PRIMEIRA ESCOLA ESTABELECIDA PELO FRANKLIN INSTITUTE, COM O ARQUITETO JOHN HAVILAND. DEPOIS DE COMEÇAR EXERCER A PROFISSÃO DE ENGENHARIA CIVIL, CONTINUOU OS ESTUDOS, PRINCIPALMENTE EM MATEMÁTICA, DA QUAL GOSTAVA MUITO. COMEÇOU SUA VIDA PROFISSIONAL EM 1825, TRABALHANDO NO CANAL DA UNIÃO DA PENSILVÂNIA E, EM 1830, NA CONSTRUÇÃO DE FERROVIAS. SUA CARREIRA COMO ENGENHEIRO TEVE INÍCIO E CRESCIMENTO COM O MAIOR DOS AGENTES EM NOSSA CIVILIZAÇÃO MODERNA, A ENGENHARIA FERROVIÁRIA. NOS ESTADOS UNIDOS, AS CONSTRUÇÕES FERROVIÁRIAS COMEÇARAM EM 1826, NA PEDREIRA DE GRANITO CHAMADA QUINCY, ONDE CONSTRUÍRAM UM BONDE PARA O TRANSPORTE DE PEDRA DA PEDREIRA PARA A ÁGUA, A UMA DISTÂNCIA DE TRÊS OU QUATRO QUILÔMETROS. ROBERTS PARTICIPOU DE IMPORTANTES ASSOCIAÇÕES. NO BRASIL FOI SÓCIO HONORÁRIO DO CLUBE DE ENGENHARIA DO RIO DE JANEIRO, ADMITIDO NO ANO DE 1881. AS CADERNETAS QUE SE SEGUEM SE REFEREM AS ATIVIDADES DA CHI E FAZEM PARTE DO ACERVO DA UNIVERSIDADE DE MONTANA.



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