

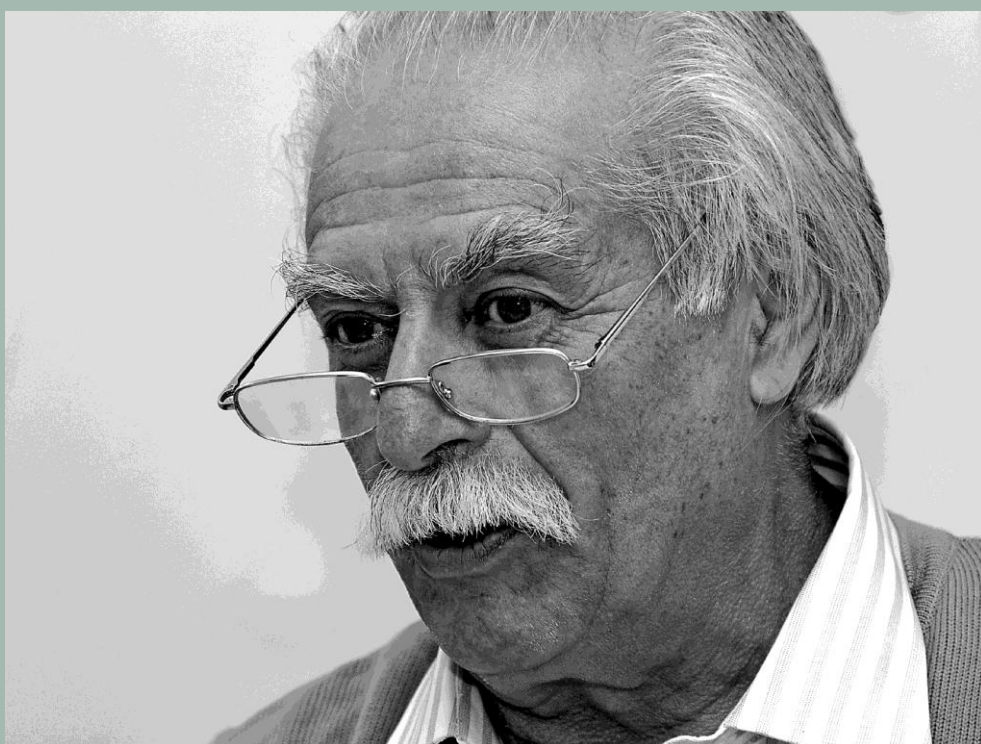
Logical and Linguistic Problems of Social Communication with the Aymara People

by
Iván Guzmán de Rojas, 1984

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Iván Guzmán de Rojas (March 30, 1934 – January 26, 2022)

PREFACE

Among the native languages of America, one has lasted and flourished despite the passage of centuries. This language is Aymara, the language spoken by the Colla (1) in the Tiahuanaco empire. These people settled the shores of Lake Titicaca three thousand years ago and still inhabit Bolivia and Peru. Neither the Incas nor the Spaniards were able to wipe out the vigorous ancestral language of the native peoples of the Altiplano (High Plateau). Both Quechuan and Spanish were forcibly imposed upon the Aymara rather than accepted willingly. However, they were unable to wipe out the Aymara language. Despite 500 years of attempts to eliminate it, the language of the lupihakes ("shining beings") still thrives in the millenary Andes. Almost two million people speak it.

Is there something special about this language that sets it apart from the many languages spoken in the Americas? The answer is yes. The first person to realize this was the Roman Jesuit Ludovico Bertonio who published a grammar and a vocabulary of the Aymara language in the early 17th century. He found that this language is remarkably fertile and articulate; that its pronunciation is unusually regular, and that it is better able than Spanish or Latin to handle abstract concepts. The learned linguist was so surprised by all this that he concluded Aymara could not be a natural language, but have been created artificially. In the early 19th century similar views were raised even more strongly by a Bolivian scientist, Emeterio Villamil de Rada, in his book, "The Language of Adam". Unfortunately, the rest of his research manuscripts could not be found after his death.

A century later, the Aymara language fascinated numerous Peruvian, European, and Bolivian scholars (some of the latter speaking Aymara as their native language). Among the latest, Bolivian researchers is Ivan Guzmán who is neither a linguist nor a fluent speaker of Aymara. He is an engineer and mathematician specializing in computer science who became interested in Aymara by chance: as he was writing some articles on the teaching of mathematics to Bolivian children, he wondered if the thought patterns involved were identical for both Aymara- and Spanish-speaking people. He found that, in principle, they are not. This surprise finding made him a full time student of Aymara.

What was this difference identified by Guzmán? Basically, it comes down to this: the logic of Aymara is trivalent, and thus differs from the bivalent logic of Spanish. That is to say, the syntax of this indigenous language is based on a non-Aristotelian logic: it has not only the two values of traditional Western logic, true or false, but three: true, false, uncertain. The logic of Spanish complies with the "principle of the excluded third"; so, inferences can only be drawn from premises which are necessarily true or false. In Aymara, logic is non-dichotomous; statements are constructed with suffixes instead of connecting words, and it is possible to arrive at conclusions from doubtful or barely plausible premisses. In other words, something can be "both perhaps true and perhaps not true"-- whether we, non-Aymara people, believe it or not --. Ambiguity has value, uncertainty matters. So, we are confronted with more than usual conflict between two different, but comparable vocabularies. We are dealing with two diametrically opposed ways of thinking which reflect cultures which are very distant from one another. Thus, the risk of failure to communicate is not just a problem of semantic differences; for example, for anyone who thinks in Aymara, "the past is in front and the future behind."

Guzmán is eager to communicate his result to all readers --not only to other specialists like himself. In this report on the research sponsored by the IDRC, the author explains in several ways the difference mentioned above: there are chapters densely packed with logical arguments and mathematical demonstration for linguists and speakers of Aymara; for the layman, there are simple enlightening examples, and even an amusing -- but effective -- instructional text: an imaginary dialogue between Aristotle and an Aymara "Indian".

What, we may ask, are the implications of distinction found by the Bolivian researcher?

It was favourable implications for the Aymara-speaking community from the point of view of social communication. Aymara-speaking people communicate among themselves using a very precise linguistic tool which is remarkably effective for conveying feelings, thoughts, and actions. However, from the point of view of social contract between Aymara- and non-Aymara speaking populations within the same country, it is not advantageous for either group. The sharp contrast between the two types of reasoning sets up serious barriers to communication between the Colla culture and the one brought by the Spanish colonizers. Sometimes the gap is so wide that translation into Spanish is almost impossible, especially when dealing with modal statements, which require an acceptance of the value of incertitude, or "principle of symmetric doubt" typical of Aymara. This greatly augments the problems of communication, not only between these two language groups, but also between organizations promoting development -in fields such as

education, agriculture, and health-- and the Aymara peasants who constitute 25% of the Bolivian population. In the other hand, the syntax of Aymara is algorithmic, which greatly facilitates translations from any other language into Aymara. (The reverse, however is not true). On this basis, a great many books printed in Spanish could be translated into Aymara using electronic equipment, which would expand the cultural horizons of the Aymara people. This would require a review of the approach to the literacy and a change in the techniques used in the Altiplano to teach the peasants to read and write. Nowever, this would not improve social communication (2) between Aymara- and non-Aymara speaking people -- a no less desirable goal.

Finally, as the reader will see, there is much food for the thought in Guzmán's study.

It is the pleasure of the international Development Research Centre (IDRC) to sponsor, and to publish in book form research such as this. At the same time, the IDRC is sponsoring a systematic description of radio programs in aboriginal languages, mainly Aymara. The work is being carried out by the Universidad Católica de Bolivia. These broadcasts started 20 years ago, and deserve special attention due to their spontaneity and liveliness. In both cases, our goal is to help science to better serve those groups, like the aboriginal peasants, who are hardest hit by the vicissitudes of underdevelopment.

The reader may or may not agree with the views presented by Guzmán in this book. They are, however, not easy to disregard, since no one can deny their potential impact upon social communication, rural education, linguistics, logic, mathematics, and even computer science and cultural anthropology. For that reason, the usefulness of this work transcends the borders of Bolivia and Peru.

LUIZ RAMIRO BELTRAN S.

Former IDRC
Regional Assistant Director
for Latin America and the Caribbean

(1)Translator's Note: The standard spelling in both Spanish and English is "Colla". Some authors have used "Kolla" (see bibliography); IGR uses "Qoya"; this latter spelling is used in the body of this work.

(2) The forerunner study in this field is Xavier Albo's "Languages, Schools and Radio stations in Bolivia". Oruro: Instituto de Investigación Cultural para Educación Popular. Publicaciones Especializadas en Educación Popular, Doc. No. 7-8, serie D, 1973. 29 p.

FOREWORD

Social communication basically demands a multidisciplinary approach; specialized studies have no practical meaning if they are not directly related to concomitant disciplines. Thus, this monograph draws upon the fields of linguistics, mathematics, and logic to analyze the problem involved in communicating with Aymara-speaking people. The author hopes readers will be patient enough to follow him in this pursuit, attempting to integrate in their own minds the apparently unrelated material presented in this monograph.

Strictly speaking, the results of my research into Aymara logic are presented in Chapter 4. The central aspect of these findings is analyzed in section 4.7, where the "Aymara siwi" is discussed. Those readers well versed in logic and the Aymara language may proceed directly to this chapter. For the others, those aspects of Aymara and formal logic needed to follow my discussion on this subject have been presented in summary form.

My sincere thanks go to the International Development Research Center of Canada, and especially to Dr John E. Woolsten, without whose encouraging support it would not have been possible to prepare this monograph.

I also wish to thank Ulla Wesner and her collaborators for their untiring and patient work in typing a text as difficult as this with a word processor while enduring the many corrections involved in elaborating the trivalent truth-tables and the orthography of the Aymara language.

Iván Guzmán de Rojas

CHAPTER ONE

550 YEARS OF DEEP MISUNDERSTANDING

A politician who harangued the peasants of the Andean Altiplano (High Plateau) saying: "Let's look ahead and forget the past..." would be running the risk of being misunderstood: even if his Aymara audience knew those Spanish words, he would simply not be able to get his message across. The misunderstanding is not merely a matter of semantics, but involves the system of logic underlying such a statement.

For anyone who thinks in Aymara, the past is in front and the future behind. Time moves relentlessly forward, regardless of what we human beings do. One cannot fail to see what has already happened, from the unknown at our backs to what can be seen in front of us. The past cannot be forgotten; it is in front of us engraved in our memories. One can "smooth out" ("pampachaña") past harshness, but one cannot fail to see past events.

The word "qaruru" (tomorrow) is composed of two elements: "qaru" (right behind) and "uru" (day); to express it the speaker gestures up and towards the back; for "masuru" (yesterday), the gestures are down and towards the front, "qepa" means both "behind" and "later".

In both Bolivia and Peru there are two separate societies. Within these two groups, life's events run parallel. Despite centuries of interaction, very little integration has been achieved. In these two countries, problems hindering social communication can only be solved by understanding the antagonism between the systems of logic of Aymara, The millenary aboriginal language, and of modern Spanish, brought to this continent just four centuries ago.

By "two different systems of logic" we do not just mean that the inferential process often arises from premises which follow different reasoning patterns, as in the above example about concepts of time. The gap is even wider: the inferential reasoning process itself follows a radically different schema, conditioned by the logical syntax of the language.

For example; let's assume you hire someone and say, "If you work, I'll pay you". In Spanish, this conditional implication has only one precise meaning: "If you have worked and I haven't paid you", the contract has been broken; otherwise, the conditions of the contract have been met. As the reader will see further on, in Aymara such an implication can be rendered in several ways, all of which specify precisely the kind of breach, not only when it is certain that "you have either worked or not", but also in case of symmetric doubt, that is to say, when "perhaps you have worked and perhaps not".

In Aymara, there are several ways of making affirmative statements having varying degrees of veracity. This has had an impact on the popular variety spoken in Bolivia and Peru, especially in the La Paz Department and other regions surrounding Lake Titicaca. In this area, people make a distinction between: "he venir nomàs"/I will come, probably / and "he de venir pues"/ I will come, for sure / (popular translations of "jutatki" and "jutatpi"). The modal suffixes used in Aymara to convey likelihood ("ki") and certitude ("pi") have been translated by the Spanish words "nomàs"/ probably / and "pues"/ for sure/, and the way these words are used in Spanish has been altered (1). In the first sentence the speaker means: "it is probable that I will come" (if I don't, I won't be breaking my word because I'm not committing myself); however, in the second sentence the speaker means: "he will definitely come" (it is a certain commitment.)

In Spanish, as in most Indo-European languages, logical statements involve connecting words, which determine their logical function (functors). Except for the imprecise use of some modal expressions, these connecting words strictly follow the bivalence principle of Aristotelian logic, also known as "the principle of excluded middle". (JL1). This principle demands that inferences be based on premisses which must be either true or false. That is to say, according to the fundamental principle of the Spanish system of logic, logical conclusions cannot be arrived at starting from

uncertain or doubtful premises, because modal statements which can have a third truth-value are unacceptable in making inferences.

There are no such restrictions in Aymara. Functors in statements are not connecting words, but suffixes. In Aymara, logical functions are determined with a remarkable degree of precision by syntactic suffixes, which consistently generate a great many logical statements which do not always have equivalents in Spanish. Some statements are impossible to translate; most of these modal statements, the interpretation of which requires accepting the truth-value of symmetric doubt; something is both perhaps true and perhaps not true".

Incredible as it may seem to anyone who thinks in Spanish, a language based on a bivalent system of logic, any Aymara-thinking person may arrive at precise conclusions from uncertain, doubtful, or barely plausible premises. Although this may seem magical, it will be mathematically proven in this book that it is possible, because of the strict rules governing the suffixes used to generate trivalent modal expressions in Aymara.

The Aymara language involves a non-Aristotelian system of logic. This fact causes a number of problems of deep misunderstanding between "Aymara-thinking" and "Spanish-thinking" people, even if the same words are used by members of these two language groups. Thus, translations is extremely difficult, especially from Aymara into Spanish, even when a good dictionary is used.

Apart from being a fascinating subject for scientific research, the study of these logical and linguistic problems may help solve the communications problems of approximately two million Aymara in the Altiplano regions of Bolivia and Peru, as well as those of some Aymara-speaking people in northern Chile, and in a linguistic island in Ecuador (see Appendices A, B and C).

Before presenting the preliminary results of the author's research, some brief information on the Qoya or Aymara culture will be summarized in the following paragraphs. The background of the source materials studied during this research will also be explained.

Some studies of Andean pre-Incan cultures indicate that the decade 1430-40 was a turning point in the history of the Qoya "nation" or "kingdom" (EIG 1, EIG 2-47). At that time, a century before the Spanish conquerors arrived in the Altiplano, the Qoya chiefs of Cuzco managed to move the kingdom's power center from the Altiplano to the valleys around Cuzco, after fierce internal fighting; this was the beginning of the Incan Empire. The ruling class of the new empire continued to use their mother tongue, today called Aymara (CMC), amongst themselves, and curiously, in secret (EWMR-3; AD). However, their own people and the people in conquered colonies were forced to speak Quechua. Although Quechua is also an agglutinative language and incorporates a large number of Aymara words, both languages are very different from one another. Communication between members of these linguistic group is impossible except for bilingual individuals, despite the fact that they one and the same people, constitute only one race (the same ethnologic variants exist within each linguistic group (EIG-554; AP2), and have the same cultural ancestry. Their millenary history probably originated in "taypi qala", an Aymara name meaning "the center stone" (now known as "Tiahuanaco"); the ruins of this site are located on the shores of Lake Titicaca, 70 kms from La Paz.

Based on accounts recorded by chroniclers during the first years following the conquest of Peru, today we know that the Incas tried to force those populations subject to their imperial might to adopt Quechua, and to that end spared no cruelty. This marked the beginning of very serious communication problems in the Altiplano. Since that time, 550 years ago, the misunderstanding has become a monstrous social problem. It should be pointed out that Aymara-speaking people have been adamantly preserving their mother tongue for the past five and a half centuries.

All efforts to wipe out the Aymara language during one century of inoculation, three centuries of resistance to Spanish colonization, and almost two centuries of Republic, have been unsuccessful. even the "Hispanicization" programs undertaken in Bolivia and Peru as a means to attaining "national unity" have been ineffective. The number of Aymara-speaking people has only decreased noticeably in the region along the Pacific coast which was usurped from Bolivia and Peru by Chile in 1879.

One wonders how the Aymara language could possibly have survived for centuries without literature or dictionaries, and despite the fact that Aymara-speaking people have been oppressed since the fall of the "jatun qoya" in 1435.

A few decades after the fall of the Roman Empire, Latin immediately ceased being a living language spoken by the people, even though it had a written grammar and literature. At present, particularly since the Agrarian Reform Act

was passed in Bolivia, use of the Aymara language is more widespread than ever. Just a decade ago, there were no radio broadcasts in any of the aboriginal languages. Now all radio stations, especially in the La Paz Department, start broadcasting in Aymara at four o'clock in the morning, when peasants begin their daily chores. Then, at seven-thirty AM, the radio stations begin broadcasting programs in Spanish for the cities. Some of them continue broadcasting bilingual programs throughout the remainder of the day.

It would be interesting to analyze the factors which have contributed to the preservation of this language for five centuries under such adverse conditions. Certainly, its remarkable syntactic structure is one factor which makes this language a highly effective means of communication, easy to pass on from one generation to the next, while preserving its syntax from influence by other languages.

The revival of an awareness of a Q'oyas nation, in which those elements of identity deeply rooted in the cultural ancestry of the Aymara people are stressed, has been accompanied by noticeable progress in scientific studies of the Aymara language and logic. The Aymara people, both in Bolivia and Peru, are awakening from a humiliating nightmare which has lasted for centuries. In those countries, record stores are now filled with Indian music, and in the not too distant future, the bookstores will be filled with books printed in Aymara. When this happens, the Roman Jesuit Ludovico Bertoni (1555-1628) will be hailed as one of the distinguished figures in Aymara history. Every student of the Aymara language agrees on the greatness of this scholar, whose scientific work as a linguist has not yet been fully appreciated. His "Grammar", published in 1603, and his "vocabulary", published in 1610, have been the most important sources used in the research on the Aymara system of logic conducted by this author (LB0, LB1, LB2).

Bertoni's work was the first complete analysis of the agglutinative structure of Aymara. His most important contribution is his description of the key role played by certain syllables in this language. He called these syllables "particles", and showed how they are used, not only to form new words, but also to determine the syntactical structure of sentences.

Bertoni was so fascinated by these particles, that he believed Aymara to be an artificial language. For instance, in his Grammar it is stated that:

(LB0-261): "One of the things which shows the artifice of this language and the diligence of its inventors, is the utilization of many particles, which by themselves are meaningless, but, when added to nouns and verbs, expand their meaning or add new ones".

(LB0-312): "After studying simple particles, it would only be normal to analyze compound ones, because the meaning they have in isolation differs from the meaning they have when added to the same verb; however, this would be such an arduous task that it would require many reams of paper. Such a complex machinery of particles and different combinations might discourage the potential student of this language. So, I will leave this to usage, the master of all things. Here I will deal only with some compound particles which, in my view, are more necessary than others". Bertoni wrote this after having devoted a whole chapter to a very thorough study of 54 simple particles (infixes and verbal suffixes). Unfortunately, he was unable, because of failing health, to proceed with the same thoroughness in his chapter on compound particles.

Bertoni was fully aware of the importance of the position and order of particles, which is now referred to as the non-commutativity of particles, especially those playing the role of logical operators. This can be seen in the following paragraph:

(LB0-316) "The relative positions of particles when added to a verb, is as important as knowing which particles can be combined with which, because if some simple particles are not arranged in their correct order, the verb's meaning is as confusing as if the wrong particles were used. Anyone who wants to learn the language well, and know in which order the particles must be attached to the verb should be guided by usage and common sense".

Among other things, those who say that Aymara has no future argue that this language cannot convey abstract concepts. Ludovico Bertoni held just the opposite view. After discussing some rules for forming so-called abstract nouns he asserts overwhelmingly: "...and, thus, it is easier to find abstract nouns in this language, and there are more of them than in Latin or Spanish (LB0-259).

Bertonio should be credited with correctly identifying the different phonemes of the Aymara language, even if the symbols he used would now be considered impractical, and "Hispanicizing". However, with the exception of a few errors in his dictionary, he recorded with great precision the various modes of articulation of consonants: normal, aspirate, and explosive or glotal. His efforts make it possible to verify that the pronunciation of Aymara has remained constant for at least the last four centuries.

For the benefit of those readers who may wish to read other publications about this language, there is a table in Appendix D which lists all the symbols used by various authors to represent the phonemes of Aymara. This table also shows the symbols used by the author in this work.

Bertonio's "Aymara Vocabulary" is really complete two-part dictionary: the first part, 474 pages long, in Spanish-Aymara; the second, 399 pages long, is Aymara-Spanish. The dictionary records approximately 18 000 words; 16 000 of these can be considered nuclei, from which some 4000 000 different words could be generated using the correct suffixes, applying the rules of generation explained in both the grammar and the dictionary. In some parts of the dictionary examples are given of how to generate variants showing how, from a single word, more than 50 new words can be formed.

Obviously, the words in Bertonio's dictionary are not sufficient to meet today's needs for social communication. For example, the "Special English Word Book" published by the "Voice of America" shows that news releases can be broadcast using just 1500 different well-chosen words, without affecting the quality of the content. Only 40% of the words listed in the "Special English Word Book" can be found in Bertonio's dictionary. That is to say, Aymara lacks an adequate complete vocabulary to meet today's need for mass communication (2). This explains why several radio programs in Aymara are interspersed with many Spanish words, even if at times the neologisms introduced are unnecessary, because the corresponding words are recorded in Bertonio's vocabulary. Sometimes, words which violate the rules of composition are forcibly introduced in this language. However, new and compatible terms which would bridge the existing conceptual gaps could be created by applying Bertonio's rules. For this reason, Ludovico Bertonio's books will continue to be the best reference work to revitalize the Aymara language so that it can meet the needs of mass communication in the modern world. Bertonio's 35 years of dedication in gathering and recording words, analyzing grammatical structures and interpreting the language is the most valuable source of information on the Aymara language, our cultural heritage and that of the word as a whole.

Bertonio's works were followed by the "Art of the Aymara Language", published by another Jesuit priest, Father Diego de Torres Rubio in 1616 (DTR). His is a very modest book when compared with Bertonio's, and although it contains only a short grammar and a vocabulary of approximately 1600 words, it is an interesting book which can be used to clarify, verify, and in some cases, complement Bertonio's monumental work.

These 17th century works had a scientific and truly empirical approach. They predate, by a century, Leibnitz's famous dissertation on the origins of language published in 1710. In this book, which marks the beginning of scientific linguistics, the German philosopher and mathematician proposed that linguistics be based upon empirical data and comparative analyses.

These publications from the first decade of colonial rule are a testimony to the efforts of the Jesuit missionaries, who used the discipline of study to understand and reach the population of conquered territories. This attitude was opposed by the Spanish monarchs, who were more interested in exploiting Indians than in understanding their culture. A climax was reached in 1740 when the pope decided to abolish the Company of Jesus. A period further tragic humiliation had begun for the Qoyas. Research and studies on the Aymara language ceased and were forgotten.

During the colonial period, the main economic activity in the Altiplano region, known at that time as Virreinato of Peru, was mineral extraction, especially gold and silver. The Altiplano Aymaras have always been unsubmissive and were better fighters than the predominantly Quechua-speaking population of the valley. Because of this, the Spanish colonizers forced people to migrate and brought Quechua-speaking people to work as slaves in the Altiplano mines. This modified the geographical and linguistic characteristics of the region. Aymara-speaking people survived only in the Altiplano zone, mainly around Lake Titicaca, where they engaged almost exclusively in agriculture, fishing, and handicrafts, although even in these endeavours they were exploited, and forced to contribute most of their production. Colonial authorities provoked rage and indignation among the Aymara population by abuse and arbitrariness.

In 1781 the Qoyas who lived in the Altiplano rebelled and laid siege to La Paz for ten months; as a result, Spanish rule almost came to an end. The leader of that Indian movement was the legendary Julián Apaza, also known as "Tupaj Katari" ("standing serpent") who was butchered, together with his wife and fellow fighter, Bartolina Sisa. At present, the "Tupaj Katarism" movement is gaining momentum in Bolivian politics. In 1979 this movement elected parliamentary representatives to the Bolivian Congress, who sometimes address the House in Aymara. In December 1979 the Bolivian government took drastic economic measures which affected mainly the peasant population. They responded by simultaneously blockading all the roads in the country, preventing food supplies from reaching urban centres. Both the government and transporters were forced to negotiate directly with the leaders of the "Tupaj Katarism" movement.

The Republic of Bolivia was founded in 1825, shortly after the creation of the Republic of Peru. These two countries were separated by an imaginary border; even the Sacred Lake (Lake Titicaca) was divided in half. Although this border hinders free traffic between both countries, it is a nuisance mainly for tourists, since the Aymara population on both sides of the border do not think of themselves as having two different nationalities. As they are not dependent upon motorized transportation, they can roam freely within their territory, which has so often been administered by foreign powers and long-vanished conquerors, who have failed to wipe out the millenary Qoya nation, as evidenced by the survival of their language.

Studies about Aymara were revived in the early years of the Republic. The first researcher in Republican times was Emeterio Villamil de Rada, born in Sorata, a city located at the foot of the beautiful "Illampu" peak in the Royal Mountain Range, 90 kms south of La Paz. This author did not have the sympathy of the Bolivian authorities and could not obtain support for his linguistic research. He committed suicide in Rio de Janeiro and most of his manuscripts were lost. His only essay to be published was "The Language of Adam" (EVR).

Villamil de Rada was probably motivated by the pioneer work of the German linguist Schlegel who, in 1808, published his "Über die Sprache und Weisheit der Indier" ("On the Language and Wisdom of Hindus"), a book which revolutionized linguistic theories. "The Language of Adam" was the first attempt to analyze possible connections between word roots in Aymara and in several other languages of the world, including Sanskrit. Though its premises are to say the least questionable its importance lies in the fact that for the first time Aymara was studied not only for its relevance to social communication, but also for its scientific importance.

Villamil de Rada also held the view that the Aymara language must have been formed intentionally, according to a deliberate plan. His views are even more radical than Bertonio's as can clearly be seen in this quote from "The Language of Adam" (EVR-322);

"First, this language was coordinated and organized previous to its formation by a preconceived idea, which made it integrally functional and rational."

"Second, abstract ideas about quantity and quality; frequency and multiplicity; restriction and expansion; depth and height; time and space; present and future; determined the forms and value of verbs as well as verb categories and meaning"

"Third, the structure of this language has remained unchanged because it is based on necessary and immutable ideas."

The loss of Villamil de Rada's invaluable manuscripts delayed the beginning of Aymara research for a century.

Another basic work which appeared in the last century was the "Aymara-Sprache" written by the German Ernst Wilhelm Middendorf (1830-1909). This book, published in 1891 (EWM-5), is extremely important for students of Aymara. It is the first grammar in which a large number of sentences used in everyday life are recorded, as opposed to the examples given by Bertonio, which were almost always aimed at catechizing the Indian.

With typical German thoroughness, Middendorf classified the Aymara suffixes, comparing them with the prefixes in German, a language which also has agglutinative characteristics. His chapter on syntax is filled with numerous extremely valuable examples, which have been of great assistance in my analysis of the logic of Aymara statements.

In his "Aymara Sprache", the author records all suffixes studied by Bertonio and gives many examples taken from the Aymara spoken in La Paz a century ago. The suffix "tayna", not recorded by Bertonio, is mentioned by

Middendorf more than once. This suffix corresponds to the modal notion of surprise, which conveys that the subject has just become aware of what has been said. This suffix has had an impact on the variety of Spanish spoken in La Paz, and has given rise to a modified form of Pluperfect. For example:

lurarapitayna (se lo había hecho)
/I had done it for him /

The introductory chapter of the "Aymara-Sprache" analyzes not only linguistic phenomena, but also the origin of the Qoya culture. Middendorf, who travelled all across the Andes, made a very detailed toponymical study, and demonstrated that the Qoya nation had stretched from the north of Bogota at "Kunturi marca" ("town of the condors") to 30o Latitude South at "Chilli Uraque" ("land's end").

The first book printed in Aymara was published by Father Beltrán, a priest born in Oruro, a mining city in the High Plateau, 200 km south of La Paz. Beltrán solved the technical problem of developing an orthography adequate to represent the speech sounds of Aymara and Quechua, and which met the following standards:

- a) all Aymara phonemes must be fully represented, without confusion;
- b) each phoneme must be represented by a single letter;
- c) handwritten form must be easy to read and write, and the letters should be easy to print.

Beltran's "Opuscles for the Civilization of the Indians", published in 1889. was the first publication to break away from a Hispanicizing type of orthography, Unfortunately, his materials were restricted to purely religious themes and Aymara-speaking people never showed much interest in his work. Several Aymara "grammars" and "vocabularies" were published at the beginning of the 20th Century. These books vary in importance, but basically nothing new or original has been added to what was already known (JAG and others).

The Aymara language was also studied by the Peruvian Juan Durand (a member of the Territorial Demarcation Commission of the Peruvian Senate, and a member of the Geographical Society of Lima), who published his interesting roonograph , "Peruvian- Bolivian Etymologies" in La Paz in 1921. Durand closely shared Middendorf's views, but he also made his own contributions; this author concluded that Aymara is the original language of the Andean cultures.

By an unfortunate coincidence, the "Peruvian-Bolivian Etymologies", like the "Language of Adam", are also a very small part of a whole collection of manuscripts lost in Lima in 1910 when the printing house in which Durand's complete works were being published was vandalized and destroyed. Durand was bitterly persecuted, and eventually deported to Bolivia.

The reasons for studying the Aymara language have ranged from the needs of evangelization to purely scientific interest; One motive has been rather curious: to study the language in order to wipe it out.

In the foreword to his "A Short Grammar of Aymara" (La Paz, 1907), Father Fernando de M. Sanjinés (FMS) openly confesses that "it is not an easy task to permanently wipe out the primitive language of a nation. It requires very hard work and utmost constancy. It also involves talking to the Indians; teaching them our language is impossible without first study theirs".

Some readers will perhaps be amused by Sanjines' views; however, they should not forget that even today, in Bolivia, Chile, and Peru there are many people who still share his views and who are truly convinced that the eradication of Aymara is both necessary and inevitable. These people forget that these views were first expounded 550 years ago.

Interest in the study of this language was revived after the National Revolution of April 9, 1952 introduced Agrarian Reform in Bolivia and land was distributed to Aymara-speaking people. Felix Equino Zavalla, at that time National Director of Agrarian Reform, decided to reprint Ludovico Bertonio's dictionary. This new edition was printed in several fascicles by Litografia Don Bosco in La Paz in March 1956, and distribute to the judges in charge of Agrarian Reform (LBI, LB2).

Since then, numerous Aymara grammars and vocabularies have been printed, both in Spanish and in English. Some are due to the authors' individual initiatives, and others, the result of team work sponsored by international organizations.

Some scientific books in the fields of historical and comparative linguistics suggest that strong links exist between the Andean languages, particularly Aymara and Quechua, and some Asiatic languages. For instance, Bertil Malmberg (BM) in his book "New Trends in Linguistics" states that "in recent years the French linguist and religious historian, Georges Dumezil, has caused a sensation by pointing out similarities between Turkish languages and Quechua, the language of the Incas, which is still spoken in the Andes by many Indians and mestizos. These similarities are so regular that they might be due to historical contacts".

Also, Mario Montano Aragon, a Bolivian researcher, recently published an interesting monograph: "Semitic Roots in Aymara and Quechua religion" (MMA). In this book, the author analyzes a great many words, both Quechua and Aymara, comparing them with Semitic expressions, especially Hebrew. K. Bauda has also published an interesting article, "Aymara and Tschimu" (KB2) in which he gives concrete evidence that "it is almost certain that Aymara belongs to, or is an essential component of, the Caucasian family of languages."

Two books which have been particularly useful in our research on Aymara logic are the grammars published by Juan Enrique Ebbing (JEE) and Erasmo Tarifa Ascarrunz (ETA). Both books feature innumerable examples of statements in Aymara, translated as faithfully as possible into the popular variety of Spanish spoken in La Paz.

Two American universities have conducted intense linguistic research on Aymara. The Department of Anthropology of the University of Florida carried out "The Aymara Language Materials Project", using a team of specialists led by M.J. Hardroan de Bautista. The first results of this investigation were published in a sizeable volume: "Outline of Aymara Phonological and Grammatical Structure" (MJHB) in which the syntactic suffixes of Aymara are analyzed using grammatical categories specifically developed for this language. Juan de Dios Yapita and Juana Vasquez of Bolivia collaborated in this research.

The University of Washington developed a course for English-speaking students (PW), which was subsequently much used by the Peace Corps volunteers working in the Bolivian Altiplano. In the foreword to that course, some paragraphs from a US Army Manual are quoted, to the effect that the revival of the Aymara language is a phenomenon of reaffirmed nationalism resulting from the 1952 revolution.

The English translations provided in these courses leave much to be desired, but they do represent a very large corpus of material in Aymara, obtained using tape recorders, and which has been very useful in my analysis of the logic of modal and connective statements:

A comparison of the material recorded in ancient grammars with that recorded in modern ones, shows that Aymara does not fit the theory of Schleicher, published in 1863, according to which languages, too, exhibit periods of development, maturity, and decline, and are subject to inevitable phonetic changes (BM). Both the syntax and the phonetics of Aymara have remained remarkably constant for centuries. However, because of the marginal conditions in which Aymara-speaking people live, their vocabulary has deteriorated, and is contaminated with unnecessary neologisms. However, it is expected that this deterioration could be remedied in a short time by promoting the use of proper Aymara words in different publications. This revitalization could be achieved by means of automatic computerized translation from Spanish into Aymara; the strictly algorithmic characteristics of Aymara syntax make this a feasible goal.

Note: Initials between parenthesis identify the authors and their publications listed at the end of this monograph. They can be used to gain access to our computerized data bank of Qoya culture.

(1) Translator's Note: The English equivalents between brackets take into account the way Spanish was deformed in Bolivia. The standard meaning of "pues" (Latin post) is "since because so then"; "nomás" means "only".

(2) Translator's Note: IGR says "social communication"

CHAPTER TWO

SOME CHARACTERISTICS OF THE AYMARA LANGUAGE

Some grammatical aspects of Aymara will be discussed in this chapter; however, it is far from being a grammar of the Qoya language. The structural characteristics of Aymara will be discussed using a few examples of sentences of that language, so that readers who do not speak it will at least have an idea of the grammatical terminology which we are forced to use in our analysis of the logical structure of Aymara.

One of the main differences between Aymara and Spanish lies in the fact that Aymara sentences are not made up of words, but of strings of syllables linked together, i.e., a succession of suffixes added to a nucleus. The grammatical function and meaning of these strings correspond to several words in Spanish. For instance, the following string is a complete statement:

"manqayarapiskatapawa" ("You would have been having him eat it")

In this string, the nucleus is the verbal root "manqa", from the verb "manqaña" (to eat). The following suffixes have been added to this nucleus: "ya" which transforms the verb "to eat" into its homologue: "to make to eat"; "rapi", indicates that the verb action is to or upon somebody; "ska" indicates the present potential modality; "ta" is the ending for the second person singular ("you"); "pa" specifies that the recipient of the action is "him" (or "her"); and finally "wa" stresses it is a perfective statement, translated in this case by the auxiliary verb "to have."

Although in the example above, the string can be interpreted rather well in Spanish, some translation difficulties should be pointed out:

a) Although the enclitic pronominal expression "it... to him" (1) accurately translates the effect of the combination of suffixes "rapi" and "pa", there is no one-to-one correspondence between the Spanish pronouns and the Aymara suffixes. As a general rule, strings cannot be interpreted on the basis of a bi-unique correspondence between Spanish words and Aymara suffixes.

b) The modality indicated by the suffix "ska" is translated using the Spanish subjunctive, although in Aymara it is a present conditional. This is so because in Spanish the Potential is, fundamentally, a tense (future relative); when it is used to form a present conditional, one must use, the subjunctive, which has some connotation of "irreality", approaching, but not completely conveying the notion of "conditionality." Mood and tense are not always independent in Spanish; however, in Aymara an absolute distinction is made between tense and (logical) mood (2). Accordingly, for a great many expressions not all shades of meaning can be rendered in translation. For example:

- manqkata - you are eating (any time)
- manqta - you were eating
- manqktawa - you have been eating

cannot be differentiated in Spanish using the "Potential" (or "Conditional") tense when the suffix corresponding to the modality of possibility is added:

- manqaskata - you would be eating (any time)
- manqaskta - you would be eating (yesterday)
- manqasktawa - you would have been eating (yesterday) (approximate translation in Spanish)

In Aymara, the last sentence involves the Potential modality (possibility) in the Present Perfect tense; the Subjunctive mood has been used in the translation because Spanish does not have a "Preterite Conditional". These difficulties will be explained in greater detail throughout this book. They are mentioned here to bring to the reader's attention the fact that grammatical categories are not the same in Spanish and Aymara.

c) The controversial suffix "wa", a source of many misunderstandings, appears in the examples given above. Bertonio thought "wa" had only an ornamental function; however, he sometimes translated it as "is"; for instance, "jaça" ("big"), "jaçawa" ("is big"). Nowadays, "wa" is translated either as "be" or "have", depending upon the content. In Spanish, the auxiliary verb "to have" is used to form a "perfect" tense, and implies that the action has been completed. To a certain degree this is equivalent to the emphasis added by the suffix "wa". However, this correspondence with the auxiliary verb "to have" has several limitations. First, in Spanish the auxiliary "to have" involves a change in verb tense, while "wa" does not. For example:

- manqta (Present-Preterite)
- you ate (Preterite)
- manqtawa (Present-Preterite of which the speaker is certain)
- you have eaten (Present Perfect; however, meaning is in the past)

Second, "wa" can be attached to different elements in the sentence; thus, the notion of perfect action or of certainty about an event can be added to the predicate, the subject, or any other element. The impact of "wa" in different parts of the sentence can be shown in the following sentences, the analysis of which follows Nicolás Fernández Naranjo's interpretation (NFN 1):

- jumaj wawajaru manqaytawa
- You have made my child eat
- jumaw wawajaru manqaytaja
- You are the one who made my child eat
- wawajaruw jumaj manqayta
- It is my child whom you made eat

Several Spanish auxiliary verbs must be used to translate the meaning of "wa" in these three sentences. In the first sentence "to have" has been used; however, in the second and third "it is...who" must be used to correctly show the stress added by this suffix when it is not a part of the predicate.

The suffix "wa" also has another connotation, which has no Spanish equivalent, but which is extremely important to understand the levels of logical modality in Aymara. As Martha Hardman (MHB1) pointed out, the Qoya language has a very peculiar grammatical category, which she calls the "postulate relative to the data source." Evidently, people who think in Aymara (even if they express themselves in Spanish) are used to specifying whether they are certain of what they say. The suffix "wa" indicates that what is said is reliable. For example, in the statement:

'Bolívar' aj markaru puriwa

The Bolívar has come to this town the suffix not only implies that Bolívar's arrival in town is completed, but also that the speaker is certain of it (because he witnessed the event). The suffix "wa" can be used to convey just the notion of a perfect action without implying the speaker can attest to the accuracy of this statement, as in the following example:

'Bolívar' aj ak markaru puri siwa

The Bolívar has come to this town, people say that additional element, "siwa", means literally "he/she has said"; in local colloquial Spanish it is "dice ché" or "diciendo" /people say/, and indicates that the speaker has only an indirect knowledge of that event.

The notions of perfect action and constancy indicated by "wa" should not be confused with the notion of certainty (modality of logical necessity) indicated by the suffix "pi". For example:

- jupaj puripi (El ha venido pues) /He has come for sure/

or also

- jupapi puri (El pues vino) /He for sure came/

In this case, the added element "pues" /for sure/, pronounced "pss" in the variety of Spanish spoken in La Paz, indicates that in the mind of the speaker the statement is necessarily true, not because he knows it directly, but because he has reached this conclusion by logical inference. A perfect tense is not necessary in Spanish; the above examples might have been translated "él vino pues" /he came for sure/ or "él pss vino" /he for sure came/.

This preliminary discussion of the peculiarities of Aymara logic should suffice to show the reader that misunderstanding exists not only between Aymara- and Spanish-speaking people, but also between Aymara-thinking people (who speak Spanish) and Spanish-thinking people (even if they speak Aymara).

Although the analysis of misunderstanding is further complicated by the fact that some Aymara-thinking people speak Spanish, the study of the colloquial variety of Spanish spoken in the Altiplano is a useful tool for analyzing Aymara logic. In this regard, Tarifa's grammar (ETA) is a valuable contribution, because the numerous statements in Aymara recorded in it are translated using Bolivianisms.

The need felt by Aymara-thinking people to express the notion of certain knowledge has led to alterations in the syntax of Spanish, which does not have this grammatical category. These distortions have been thoroughly studied and explained by N. Fernandez Naranjo in his Dictionary of Bolivianisms (NFN). This author points out that "preference for the Present Perfect over the Preterite i.e., "has come" instead of "came" is due to the psychological need to express the certainty conveyed by the suffix "wa" in Aymara.

Another fine point of Aymara grammar should be brought to the reader's attention, viz, the existence of a "letter" which, is not pronounced and which causes the vowel preceding it to dis In this book this letter is referred to as an "elitor", and the symbol "l̥" is used to represent it. The elision can occur either in the middle or at the end of a string. Also, the elitor may appear alone, followed by other letters, or joined to some suffixes, and thus, it plays a very important role in the order of suffixes in any string. For example, the suffix "/ka", by itself forms the present modality in the conjugation:

- manqa/kata = manqkata (you are eating)
- manqasu/kata = manqaskata (you would be eating)

The combination of suffixes "/ka" and "ti" generates a negation:

- `tanta utji (There was/some/ bread)
- janiw`tanta utjkiti (There was no bread)

In this example, the string "utjkiti" is more complex than it would appear at first glance. Its structure is:

RVB.I2.Tl.P4.L7

Following are the symbols used in this formula: "." means "linked to", i.e., the continuous union of that which precedes and whatever follows the symbol; "RVB" means "verbal root", which in our example is "utja" (from the verb "utjaña", equivalent to "/there/ be", "be in existence"); "I2" is the second suffix in category I (Modal Inductor), which in this case is "/ka", corresponds to the present modality (gerund); "T1", the first suffix in category T(Tense)correspondsto the Present-Preterite of Aymara, which is the elitor "/"; P4 is the fourth suffix in category P (Person) and corresponds to the fourth person ("he" or "she") of Aymara; and finally "L7", "ti", is the seventh suffix in category L (Logic), which corresponds to interrogative statements (when combined with I2 it generates negation). Thus, the string "utjkiti" is derived from:

RVB.I2.Tl.P4.L7. = utja./ka./i.ti = utj/ka/iti = utjkiti

Although to a Spanish-thinking person this may look incredible, it is a very simple string which any Aymara 7-year old can master perfectly even if he cannot write!

In the above example, the adverb of negation "jani" (no) is followed by the suffix "wa" (I have direct knowledge that there is no bread); the elision of the last "a" is due to the addition of the suffix "K1", which also includes the letter "/". Below, the syntactic role of K1, the first suffix in category K (Kasus) will be explained.

For the time being, the reader must bear in mind that the distinction between suffixes does not depend solely upon the particles or letters which comprise them. Both the relative order of a suffix in any string and its function are also very important. This explains why "/" is sometimes classified as T1 and at other times as K1.

The same applies to the particle "ni". This particle can represent up to four different suffixes, depending on its position and function. For example:

- uta (house) utani (house owner, proprietor)
- jutaña (come) jutaniña (return to the place where one came from; with verbs of movement;
- saraña (go) sarani (to have to go; let's go!)
- manqaña (eat) manqaniña (to go to eat; with action verbs)

The Qoya language has more than twenty suffix categories; some of these include only two suffixes, and others more than ten, for a total of over two hundred suffixes, some of which may be combined within the same category (cf. Bertonio's "machinery of particles"), a fact which might discourage beginners trying to learn this language. Fortunately, any chance of confusion is eliminated because these suffix categories are clear-cut and their use is very consistent and easy.

This short monograph will analyze those suffixes directly involved in the logic of statements. The others, which will necessarily appear in the examples, will not be explained systematically, but will only be translated into Spanish, with their meaning in Aymara rendered as accurately as possible.

In Aymara logic there are only nine simple suffixes which fall into two categories: I (Modal Inductor) and L (Logic). These suffixes will be analyzed in more detail in chapter 4, following a discussion of some essential concepts relating to trivalent logic and the use of truth-values, necessary to an understanding of the modalities which these suffixes generate. Before concluding this brief presentation of some special characteristics of Aymara, the author would like to comment upon two aspects which, though well known to scholars of Aymara, are not always clearly understood by "communicators" even if they speak (grammatically) correct Aymara.

In Spanish, the article plays two roles: 1) it limits and gives definiteness to nouns and, in some cases, to verbs (for example, "el tanto andar me cansó" / "so much walking made me tired"/; 2) it indicates the gender of the noun. In Aymara, nouns have no grammatically marked gender. Some nouns which refer to persons are specifically feminine or masculine, i.e., "warmi" (woman) and "çaça" (male, man), but, in general, things have no gender. For instance, "inti" (sun) is neither masculine like "el sol" in Spanish, nor feminine like "die Sonne" in German. The word "jaqe" means "man", in the general sense of "human being" (Mensch in German), but has no gender and can be used both for men and women. Also, the pronoun "jupa" means both "he" and "she". Thus, there can be no "sexism" when one speaks Aymara.

However, even if there are no articles in Aymara, there are, as is explained below, two suffixes, K1 and L1, which have greater syntactic flexibility than Spanish articles and may determine not only nouns, but also any complete string. For instance, in Aymara determiners can be used with proper names, whereas proper names in Spanish cannot be preceded by a definite article. For example:

'Pedroi puriwa.' (The Peter has arrived)

In this example, the subject consists of the string NOM.L1.K1, that is to say, the name plus the suffixes "ja" and "/", which determine it (implying: The little Peter, the one we know well). This feature is apparent in the colloquial Spanish spoken by Aymara-thinking people, who usually add the article and the diminutive ending to proper names, to make up for the missing functions of L1 and K1. Speakers feel that the Spanish sentence "Pedro ha llegado" /Peter has arrived/ is "bare" (the reader may wonder which Peter it is).

Although the functions of the Spanish definite articles are covered by suffixes K1 and L1, they fall into the syntactic category of "pointers" as found in artificial computer languages. Like pointers in a data base, the string which contains the pointer is linked by K1 and L1 with w other string(s) containing determining or characterizing data.

The reader should be aware of another aspect: In Aymara there are 4 personal pronouns; in Spanish there are only three. The 4 Aymara pronouns are:

singular	plural
1) jiwsa (you and me, both of us)	jiwsanaka (all of us, inclusive term)
2) juma (you /sing/)	jumanaka (you /plural/)
3) naja (I)	nānaka (we, mine, exclusive term)
4) jupa (he, she)	jupanak (they)

The "j" in "naja" is very soft; this word is sometimes pronounced "nä" (double vowel) and also "naya". The pronouns have been listed in their order of priority in Aymara. Conversation always involves a dialogue between two people (sometimes a few people), represented by "jiwsa", translated into colloquial Spanish by "nosotros dositos" /both of us/, or also "nosotritos" /those of us who are talking/. "jiwsa" is an archaic form (LBI, DTR); today the common form is "jiwasa".

To form plural pronouns; the plural suffix "naka" and a verb inflection are added to the singular pronouns; for example:

- jiwaj manqtanwa (Nosotritos hemos comido) /Both of us have eaten/
- jiwanakaj manqapjtanwa (Nosotros todos hemos comido) /All of us have eaten/

The suffix "pja" indicates plural in the conjugation. This is one of the few particles which has undergone some phonetic change: Ancient grammars (LB, DTR) record its pronunciation as "pesqa"; however, its position in the predicate string has remained unchanged.

The plural is formed by adding "naka" to nouns, but never to adjectives. This element is almost, but not quite, equivalent to the Spanish "-s". It is closer to the quantitative adjective "several". This causes some communication problems. When Spanish-thinking persons speak Aymara they use "naka" too often because of the frequency of the plural ending "-s" in Spanish. They mistakenly assume that gramatical categories of Spanish are "universally correct." For instance, the sentence:

- "Mis tres hijos grandes han llegado". /My three big sons have arrived/

Is translated into Aymara by Spanish-thinking people as follows:

- "kimsa yoqanakaja jaçanaka puripjewa."

This "translation" sounds ridiculous and would be irritating to an Aymara. If the sentence were translated back into Spanish it would mean something like this:

- "Tres de mis varios hijos variadamente grandes han llegado".
- /Three of my several variously big children have arrived/

In correct Aymara "naka" is not required, and the adjective must always precede the noun:

- "kims jaça yoqajaj puripjewa."

The excessive use of "naka" is very common among Spanish-thinking religious preachers.

Sometimes people erroneously assume that the repetition of a noun makes it plural. This is not so. In Aymara such a repetition generates a new collective (singular) noun. For example: "qala" (stone); "qala qala" (stony ground).

Finally, the terms "translation" and "explanation" as used in this monograph must be defined. Translation from one language into another involves generating sentences which closely represent the meaning of the sentences in the original language. It is not necessary for this faithful representation to be a word-for-word translation. What matters most is that the sentences in the target language accurately convey the meaning of the sentences in the source language.

Evaluating a translation is far from easy because it involves defining criteria to determine how faithful the sentence in the target language is to the idea in the source language. These criteria cannot only be syntactic and semantic. For instance, among the common people in La Paz one frequently hears, sentences like:

- "El Pedrito habià llegado." (in Aymara: pedroj puritayna.)

This sentence cannot be translated into English, although it may be grammatically represented by:

- "The little Pedro has arrived."

Translation is difficult because in English the article not used before names, there are no diminutive endings, and there is no verb tense for the pseudo-Pluperfect of surprise. These grammatical categories have been transferred from Aymara into the variety of Spanish spoken in the Altiplano (the correct Pluperfect forro in Spanish is "habia", not "había").

Of course, an English-speaking person can be given an explanation of the real meaning of any sentence using illustrative examples, but this is not a translation, according to the definition given above.

This work does not attempt to discuss the many conceptual categories commonly used in Aymara. Instead, the subject of study is the logical categories implicit in the syntax of the Qoya language. As these categories sometimes do not have a Spanish equivalent, it will not always be possible to translate statements from Aymara into Spanish; however, they will be explained as precisely as is required by logic using some mathematical symbols. Therefore, the reader must be patient with and tolerant of our utilization of certain symbols and truth-tables, as these tables will help to understand more clearly the differences between Spanish and Aymara logic, and will also help to avoid imprecise wordiness.

Note: The symbols used to transcribe Aymara phonemes are explained in Appendix D.

(1) Translator's Note: It is not enclitic in this example (neither in Spanish nor in English)

(2) Translator's Note: IGR says "modality."

CHAPTER THREE

THE TRIVALENT LOGIC OF AYMARA

Read more at the Guzmán de Rojas's [ATAMIRI website](#)

Greek science is the classic example, par excellence, of a normal science, whose paradigms, according to Kuhn (TK), have lasted thousands of years. The geometry of Euclid (330 BC) reigned triumphant and undisputed until the introduction of non-Euclidean geometries by Gauss (1777-1855), Lobachewsky (1793-1856), Boylai (1802-60), and Riemann (1826-66). The logic of Aristotle (382-322 BC) is even more resistant to change because it is immersed in the languages which reflect the Western mode of thought.

Immanuel Kant (1724-1804), philosopher and Professor of Logic at Koenigsberg, was fully convinced that "Aristotle did not omit any essential aspect of knowledge; it only remains for us to become more precise, methodical, and orderly."

The research of the Polish thinker J. Lukasiewicz was a sharp departure from the Aristotelian interpretation of logic. Lukasiewicz, a leading member of the Warsaw school of logic, published his paper "O logice trojwartosciowej" ("On Trivalent Logic") in 1920. This publication, the point of departure for non-Aristotelian systems of logic, was not translated into Spanish until 1975 (JL1).

According to J. Ferrater Mora (JFM), there is some evidence that William of Occam (1298-1349) had already suggested the use of three truth-values. Ferrater Mora also indicates that around 1910, the "Russian mathematician N. N. Vasilev of the University of Kazan, published several articles in which he put forward and developed a three-valued logic. Vasilev's fundamental idea consisted in transposing to Logic the rules followed by Lobachewsky in founding his non-Euclidean geometry. Lobachewsky, who had been a Professor at the same University, developed his geometry by eliminating the parallel postulate. Likewise, Vasilev developed his trivalent logic, which he called "non-Aristotelian logic", by eliminating the law of excluded middle. However, the most important and influential contemporary publications on polyvalent logic have been published by Jan Lukasiewicz, Emil L. Post, and Alfred Tarski."

In 1930, Lukasiewicz published his paper "Philosophische Bemerkungen zu mehrwertigen Systemen des Aussagenkalkuels" (Philosophical Observations on Polyvalent Systems of Propositional Logic). In this paper the author explains his ideas in great detail, from the point of view of both logic and philosophy. He analyzes the consequences of modal statements which, within the limited framework of bivalent logic, "go against all our intuitions." He also clearly demonstrated the incompatibilities of theorems regarding modal propositions in bivalent propositional calculus" (JL1-69).

In order to give the reader some idea of the insight and courage it took to break with the Aristotelian tradition, I would like to quote the following paragraphs from Lukasiewicz' above-mentioned paper:

"When I became aware of the incompatibility of traditional theorems of modal propositions in 1920, I was in the process of establishing a normal bivalent propositional calculus based on the matrix method. At that time I was convinced that it was possible to demonstrate all the thesis of the ordinary propositional calculus assuming that propositional variables could take on only two values, "0" (false), and "1" (true). This assumption corresponds to the basic theorem that every proposition is either true or false. For brevity's sake, I will refer to it as the law of bivalence. Although it is sometimes referred to as the law of excluded middle, I prefer to restrict this latter term to the well known principle of classical logic which states that two contradictory propositions cannot both be false at the same time."

"Our whole system of logic is based on the law of bivalence, even though it has been fiercely disputed since ancient times. Aristotle knew this law, but he questioned its validity as it referred to future contingent propositions. The law of bivalence was flatly rejected by the Epicureans. Chrysippus and the Stoics were the first ones to develop it fully and incorporate it as a principle of their dialectic, the equivalent of modern day propositional calculus. The arguments regarding the law of bivalence have metaphysical overtones: its supporters are resolute determinists; whereas its opponents generally have an indeterministic Weltanschauung. Thus, we are once again in the area of concepts of possibility and necessity."

In the following paragraph, Lukasiewicz discusses an interesting example of a logical statement using the future tense, and demonstrates that it is not possible to affirm whether it is either true or false, because it is basically uncertain. Next, Lukasiewicz discusses the definitions of his trivalent propositional calculus, which is based on just two three-valued logical propositions, negation and implication, and from which he developed all the remaining propositions necessary for a complete logical system.

Some examples of statements in Spanish may be beneficial for readers unfamiliar with the terminology used in logic. In all languages there are several kinds of sentences. Statements are a kind of sentence. They have both objective and logical meaning, and can be assigned a truth-value. For example:

- "It rained yesterday"
- "It did not rain yesterday"
- "If it rained yesterday, then the road is muddy"

are statements, because apart from the objective meaning involved in the concepts of "rain" and "muddy", they can also be evaluated as to their truth or falsity. However, sentences like:

- Where did it rain?
- It, is really pouring!
- aymara yateqañani (we must learn Aymara!)

are not statements because it is not possible to decide whether these sentences are true or false, i.e., they cannot be assigned a truth-value.

Logic is only interested in the truth-value of statement regardless of any conceptual content they may also have. In textbooks of logic, statements are also called "logical propositions."

The main subject of logic is inference, a process by which a conclusion is reached from one or more premises. Premises and conclusions are always statements, i.e., sentences which have specific syntactic characteristics in each language (in which people reason). The consistent use of given syntactic structures develops the operating mechanisms by which the human mind makes inferences. Let's consider the following inferential schema:

- Premise 1: If it rains, there is mud.
- Premise 2: There is no mud.
- Conclusion: Therefore, it did not rain.

The logical conclusion arrived at does not depend on the conceptual meaning of the statements in the schema. This inferential schema may be expressed formally by saying:

- "When x implies y , and y is false, one always infers x is also false; symbolically, $x \Rightarrow y$ "

The concept of implication can be understood using syntactical forms such as: "*if x ... then y ...*", or forms similar to this. The consistent use of logical meaning in language patterns makes it possible to infer. Any person or computer capable of understanding such syntactic structures can arrive at logical conclusions, though other forms of expression in the language may be primitive.

There is no one universal logic underlying the syntactic structures of all languages. Logic meets the need of man, or of the computer, to manipulate truth-value relations. This need is conditioned, however, by a set of truth-values,

adopted at a metalogical level, which are at the basis of the system of logic one wants to operate with. This metalogical level is in turn processed through language, which already has its own logic. The question then arises: how does one switch from one system of logic to another?

The history of logic shows us that it is not possible to switch logic systems while remaining within the conditioning framework of one language. This can only be achieved by resorting to another language. Up to now, recourse has been the formal language of mathematics, whose syntax makes it possible to define structural generalizations. Lukasiewicz used mathematics to generalize bivalent truth-tables and define trivalent truth-values from which he developed a new system of logic which, unlike Aristotle's, can only be understood using formulas.

The mathematization of Aristotelian logic dates back to Boole (1815-1864). Boolean algebra operates with two truth-values: *True* ("1"), and *False* ("0"). Using these binary digits it is possible to unambiguously express any bivalent logical function. Electronic circuits are also binary; thus, computers also "think" according to Aristotelian logic.

To avoid confusion with the notation used in this book for the ternary digits of trivalent logic, "false" will be written "-1" rather than "0" in both the bivalent and trivalent truth-tables. Boolean algebra cannot describe Aymara logic, so it will not be used in this book; therefore, the notation adopted will not lead to any confusion.

A "logical variable" is a symbol, for example " x ", which represents the truth-value of a given statement. A "logical function", or "functor" for short, is a relationship $p(x)$ which assigns a truth-value p according to the values of one or several variables. In bivalent logic there are only four one variable $p(x)$ functors which may be represented by the following truth-tables:

x	1	-1	(it is raining)	affirmation of x
$N(x)$	-1	1	(it is not raining)	negation of x
$T(x)$	1	1	(it is either raining or not)	tautology of x
$-T(x)$	-1	-1	(it is raining and it isn't)	contradiction of x

Also, there are only 16 two-variable functors $p(x,y)$; the most widely used in everyday language are:

x	1	-1	1	-1	.
y	1	1	-1	-1	.
$x \wedge y$	1	-1	-1	-1	conjunction (x and y)
$x \vee y$	1	1	1	-1	alternative (x or y)
$x \Rightarrow y$	1	1	-1	1	implication (if x then y)

Truth-tables show the values of a given functor for all possible values of its variables.

The great advantage of truth-tables is that they make it possible to precisely define the logic of sentences in any given inferential schema, regardless of the language used. Moreover, truth-tables are an indispensable tool for reaching conclusions from several complex premises. These conclusions would be very difficult or impossible to arrive at by a process of purely mental inference. Also, this is the only way complicated logical instructions can be given to a computer.

The following example will illustrate how truth-tables are used:

Statements:

- x = it has rained
- y = there is mud

Premises:

P1 : $x \Rightarrow y$	"if it has rained, there is no mud"
P2 : $N(y)$	"there is no mud"

Truth- Table

	x	1	-1	1	-1
	y	1	1	-1	-1
P1	$x \Rightarrow y$	1	1	-1	1
P2	$N(y)$	-1	-1	1	1

The fourth column is the only one which satisfies both premises; thus, $x = -1$ (the logical conclusion is, "it has not rained").

The following example is less obvious: we want to infer whether there was a full moon last night and whether it is raining today, knowing either that there are or there are not reddish clouds in the sky; the following inferential schema is used:

Statements are:

- x = it is somewhat cloudy
- y = last night there was a full moon
- z = it is raining

The premises are:

- P1: it is true that if it is somewhat cloudy there was no full moon last night: $x \Rightarrow y$
- P2: it is not true that if it rains it is somewhat cloudy: $N(z \Rightarrow x)$
- P3: it is not somewhat cloudy: $N(x)$

There are three propositional variables, so there are $2^3 = 8$ combinations of binary digits; thus, the corresponding truth-table must have 8 columns (or rows, depending on how it is displayed):

		1	2	3	4	5	6	7	8
	$x =$	1	-1	1	-1	1	-1	1	-1
	$y =$	1	1	-1	-1	1	1	-1	-1

	z=	1	1	1	1	-1	-1	-1	-1
P1:	$x \Rightarrow y =$	1	1	-1	1	1	1	-1	1
P2:	$N(z \Rightarrow x) =$	-1	1	-1	1	-1	-1	-1	-1
P3:	$N(x) =$	-1	1	-1	1	-1	1	-1	1

In this example of inference, the truth-table shows two columns (2 and 4) which contradictorily satisfy the premises; therefore an unequivocal logical conclusion cannot be reached.

The table shows that the set of premises is satisfied both if there was a full moon last night and if there was not, i.e., instead of a logical conclusion we have a contradiction. To solve this contradiction we must reword our premises less categorically using modal expressions which reflect the uncertainty of our knowledge about the implied causal relationships.

As the premises were formulated within the framework of bivalent logic, they cannot represent the concepts of possibility or probability which might have been more appropriate. These statements cannot be formulated with absolute certainty because of their content (uncertainty in the prediction of meteorological phenomena).

Unlike computers, human beings require a more flexible gradation of truth-values than the absolute "either...or." Aristotle himself was aware of this, when he introduced the notions of "possibility" and "contingency" into his modal logic. These concepts of logical modality were first formulated by the American logician Lewis who developed a set of axioms to interpret the concept of "strict implication."

Lukasiewicz used truth-value tables to define his trivalent functors, from which he consistently developed the theorems of modal logic. Lukasiewicz used the symbols 1 , $1/2$ and 0 to denote the three truth-values of his trivalent logic. Unlike Boole's binary digits, these symbols are numerical, but not algebraic: one cannot perform operations with them; they are only used to display truth values: $1 = \text{true}$; $0 = \text{false}$; $1/2 = \text{a third truth-value, equidistant from both: "perhaps true and perhaps false."}$

As will be explained later, although it is also trivalent, Aymara logic is more general than Lukasiewicz's logic, because it is algebraically structured. For this reason, the symbols used for the three truth-values are also ternary digits which can also serve as operators; this makes it possible to handle a larger number of functors than those studied by Lewis and Lukasiewicz.

For those who may wish to consult Lukasiewicz's works, the following table shows the equivalence of symbols used to denote trivalent truth-values:

Representation of trivalent truth-values

Logic	true	perhaps true and perhaps false	false
Boole (binary digits)	1	none	0
Lukasiewicz (it is not an algebraic digit)	1	1/2	0
Aymara (trinary digit)	1	0	-1
Aymara adverb	jisa	ina	jani

	(yes)	(perhaps yes and perhaps no)	(not)
--	-------	------------------------------	-------

Lukasiewicz's approach is new: according to him modal and connective functors are defined according to the following truth-tables which he says "were obtained after detailed consideration and which are more or less plausible": In this work the following symbols are used:

x, y	elementary amodal statements
$p(x), q(x)$	elementary modal statements
$p(x,y), q(x,y)$	biconnective statements

Connective statements having more than two variables be considered in this monograph.

Modal Functors $p(x)$ according to Lukasiewicz

$x =$	1	0	-1	amodal statement
$N(x)=$	-1	0	1	negative statement
$G(x)=$	1	-1	-1	statement of certitude ("Gewissheit")
$M(x)=$	1	1	-1	statement of possibility ("Möglichkeit")

Connective functors $p(x,y)$ according to Lukasiewicz

$x=$	1	0	-1	1	0	-1	1	0	-1	.
$y=$	1	1	1	0	0	0	-1	-1	-1	.
$x \Rightarrow y=$	1	1	1	0	1	1	-1	0	1	Conditional $C(x,y)$
$x \vee y=$	1	1	1	1	0	0	1	0	-1	Alternative $A(x,y)$
$x \wedge y=$	1	0	-1	0	0	-1	-1	-1	-1	Conjunction $K(x,y)$
$x \Leftrightarrow y=$	1	0	-1	0	1	0	-1	0	-1	Equivalence $E(x,y)$

In any trivalent system of logic there are $3^3 = 27$ modal functors and $3^9 = 19,683$ connective (two-variable) functors! As will be demonstrated in the next chapter, these many functors may be dealt with using the logical suffixes of Aymara syntax (just nine modal operators and a subordinative operator). All of them are used in the language as currently spoken: The following examples are useful in illustrating this point:

Some modal functors of Aymara : $p(x)$

$x.wa =$	1	0	-1		amodal statement of irrefutability
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x.ka.pi =	-1	0	1	=N(x)	modal notion of negation
x.pi =	1	-1	-1	=G(x)	modal notion of certitude
x.ça =	-1	1	1		modal notion of doubt
x.sû =	1	1	-1	=M(x)	modal notion of possibility
x.ki=	1	0	0		modal notion of likelihood
x.çi =	0	1	0		modal notion of contingency
x.sa.çi =	1	1	0		modal notion of plausibility (+)
x.ti.çi =	0	1	1		modal notion of plausibility (-)

The notation used here is based on the Aymara suffixes used, to generate logical statements. For example, the suffixes "ka" and "ti" are used to generate negative statements; thus, the negation of x is symbolized x.ka.ti. For example:

x.wa	=	jutätawa	you will come
x.ka.ti	=	janiw jutkätati	you will not come
x.çi	=	inaj jutçita	you might come
x.sa.çi	=	inaş jutçita	perhaps you will come
x.ti.sa.çi	=	janiti inaş jutçita	perhaps you will not come

The next chapter explains the method followed to assign a certain truth-table to any given simple or complex Aymara suffix, be it a modal or a connective functor.

Before concluding this brief introduction to trivalent logic and its relationship to the modal suffixes of the Aymara language, let us use the functors of the language to reword the statements in the inferential sohema given as an example. The examples will now read:

x.wa = 'qenayrantatanwa' ('it is somewhat cloudy')

y.wa = 'masarma pajsinwa' ('there was a full moon last night')

z.wa = 'jallunwa' ('it has rained')

Using Aymara modal forms, the premises are:

P1: x.ka + y.sû + xy.lla.pi = 1

'qenayrantatkiwa masarma pajsispawa tullanpi; çeçawa.'

'having been somewhat cloudy last night, it is possible there was a full moon but; it is correct.'

P2: $x.k.a + y.su + xy.l.a.p.i = -1$

'jallkiwa qenayrantataspa tullanpi; janiw çeqkiti'

'being raining possibly it would be somewhat cloudy but; it is not correct.'

P3: $x.k.a.ti = 1$

'janiw qenayrantatkiti'

'it is not somewhat cloudy'

Using trivalent truth-tables, logical analysis now demands a table of $3^3 = 27$ columns, of which only eight (no zeros) correspond to the bivalent table:

x=	1 0-1	1 0-1	1 0-1	1 0-1	1 0-1	1 0-1	1 0-1	1 0-1	1 0-1
y=	1 1 1	0 0 0	-1-1-1	1 1 1	0 0 0	-1-1-1	1 1 1	0 0 0	-1-1-1
z=	1 1 1	1 1 1	1 1 1	0 0 0	0 0 0	0 0 0	-1-1-1	-1-1-1	-1-1-1
P1 =	1-1 0	1-1 0	-1 0 1	1-1 0	1-1 0	-1 0 1	1-1 0	1-1 0	-1 0 1
P2 =	-1-1 1	-1-1 1	-1-1 1	1 1 0	1 1 0	1 1 0	0 0-1	0 0-1	0 0-1
P3 =	-1 0 1	-1 0 1	-1 0 1	-1 0 1	-1 0 1	-1 0 1	-1 0 1	-1 0 1	-1 0 1

Now the situation has changed radically, because column 9 makes it possible to infer an unequivocal conclusion from the premises. That is to say, one arrives at the logical conclusion that:

- $y = -1$ (there was no full moon last night)
- $z = 1$ (it has rained)

The inference is possible because the premises have been toned down. Provided the premises are true, the conclusion reached is also true. Premises which have some elements of "indetermination" make the conclusion less certain compared with an inference based on more "categorical" premises. However, even a clear conclusion with some degree of uncertainty is preferable to a contradiction.

Although the truth-table shows that the inference in our example is perfectly valid, the fact that it is possible to arrive at a very precise conclusion from a set of premises loaded with "uncertainty" must seem absurd, or at least very strange, to minds programmed" according to Spanish bivalent logic. However, as modal suffixes always "program" trivalent truth-tables, people who have been dealing with them since early childhood will be content with conclusions arrived at from modal premises whenever it is not possible to make inferences from true clear-cut premises, because of a lack of information or where aspects of contingency are involved.

It is always more useful to be able to make decisions even if they involve a certain degree of risk, than to do nothing simply because the result will not be certain. This is the practical advantage of using modal logic to make inferences.

Spanish-thinking people feel that "uncertainty is unbearable" and has nothing to do with logic, whereas for an Aymara-thinking person, "ina" is a part of reality, and is as logical as "jisa" or "jani". If Lukasiewicz had been a Qoya, he would probably have considered the bivalent logic of Spanish-speaking people as strange and worthy of study as polyvalent systems of logic.

CHAPTER FOUR

THE LOGICAL SUFFIXES OF THE AYMARA LANGUAGE

This chapter deals with the central ideas of the two methods of analysis used in this book to show that the syntax of the Qoya language is based on a trivalent system of logic. The first concept to be analyzed will be that of "kimsaku" (or "triad of truth-values of a functor").

Let us recall that all modal statements consist of two parts: the "dictum" (matter about which something is said), and the "modus" (degree of truth accorded the statement: modality.)

The dictum is expressed by a predicate, whereas the modus requires adverbs such as "certainly", "possibly", "perhaps", etc.

In this book, "formal statements" will often be used to translate the modal meaning of a given suffix; for example, "it is plausible that x ". The reader is advised not to interpret the truth-tables in this book from these formal statements in Spanish. Although these Spanish expressions are close enough to the meaning of Aymara statements, the particular words used have been chosen arbitrarily. The kimsakus have been obtained directly from the logical suffixes of the Aymara language.

Following convention, the letters x, y, z , will be used for , amodal statements (which have only dictum). The letters p, q, r , will be used for modal statements (which comprise a dictum x and a modality generated by an Aymara suffix S .) For example,

$$p(x) = x. S$$

may represent the following:

$$x = \text{muni (he wants)}$$

$$p(x) = x.p_i = \text{munipi(he wants for sure)/(he necessarily wants)}$$

4.1.- The kimsaku of a functor

As has already been explained in this book, "functor" means the function $p(x)$ which is dependent on the propositional variable x . To facilitate the consistent use of truth-tables for modal and connective statements, let us analyze the following triad of ordered values:

$$(p(1), p(0), p(-1))$$

The order chosen for $x = 1, 0$, and -1 (affirmation, symmetrical doubt, and negation) is arbitrary. However, this order must be respected so that the truth-tables in this book may be compared. Thus, the above triads will be called "kimsaku of statement $p(x)$ ", and written:

$$p(x) = (p_1, p_2, p_3)$$

$$\text{where } p_1 = p(1), p_2 = p(0) \text{ and } p_3 = p(-1)$$

If " S " is the Aymara suffix, either simple or compound, which generates the statement having $p(x)$ as a functor, then this will be written:

$$x.S = (p_1, p_2, p_3)$$

In the case of two-variable connective statements $p(x,y)$, one does not have a triad, but a 9-element bitriad, which will be called "päkimsaku". The following order will always be respected:

x=	1	0	-1	1	0	-1	1	0	-1
y=	1	1	1	0	0	0	-1	-1	-1

päkimsaku $p(x,y)=p(1,1), p(0,1), p(-1,1), p(1,0), p(0,0), p(-1,0), p(1,-1), p(0,-1), p(-1,-1)$

Note: In Aymara, "kimsa" means "three"; "paya" means "two"; and "pä" can be translated using "a pair (of)" or by the prefix "bi".

Two statements, $p(x)$ and $q(x)$ are said to be logical synonyms whenever,

$$(p1, p2, p3) = (q1, q2, q3)$$

Two statements, $p(x)$ and $q(x)$, are said to be logical opposites if one negates both the modus and the dictum of the other statement, i.e., whenever,

$$(p1, p2, p3) = (-q1, -q2, -q3)$$

for example:

"it is possible that it will rain" is the opposite of "it is impossible that it will rain." :

$$(1, 1, -1) \text{ is the opposite of } (-1, -1, 1)$$

Two statements, $p(x)$ and $q(x)$, are said to be logical "antonyms" when one negates only the dictum of the other statement, in other words when

$$(p1, p2, p3) = (q3, q2, q1)$$

for example:

"it might rain" is the antonym of "it might not rain"

$$(1, 1, 0) \text{ is the antonym of } (0, 1, 1)$$

Note: In Aymara there are no homonymous statements, i.e., statements having two or more different logical functions. Thus, a suffix, either simple or compound, can have only one kimsaku. However, because of logical synonymy, a kimsaku can be generated by different suffixes; nonetheless, simple suffixes have no synonyms.

4.2.- Method of logical analysis to determine of a statement

The values of the kimsaku $(p1, p2, p3)$ corresponding to any modal statement $p(x)$, can be found by following the steps set out below:

1.- It is assumed that the modal statement originates in a dialogue between a proponent, who makes an amodal statement x (having no modus, only dictum), and an opponent, who made a modal statement $p(x)$ (having modus and dictum) about the same matter (same dictum), expressed by the Aymara suffix S.

2.- The proponent's amodal statement is always assigned the following kimsaku:

- $x = (1, 0, -1)$

the opponent's modal statement $p(x) = x.S$ has the following kimsaku

- $p(x) = (p1, p2, p3)$

where "S" represents the corresponding Aymara suffix which generates the modality in statement $p(x)$.

3.- To determine the values of $p1$, $p2$, and $p3$, the proponent's and opponent's statements are compared; this results in the following determinations:

Determination of $p1$: if when the proponent is right ($x=1$), we have:

- the opponent is right (that there is positive certitude about x), then $p1=1$;
- it cannot be known whether the opponent is right, then $p1 = 0$;
- the opponent is not right; then $p1 = -1$.

Determination of $p2$: if when it cannot be known whether the proponent is right ($x = 0$), we have:

- the opponent is right (that there is doubt about x); then $p2 = 1$;
- it cannot be known whether the opponent is right or wrong, then $p2 = 0$;
- the opponent is not right; then $p2 = -1$.

Determination of $p3$: if when the proponent is not right ($x = -1$), we have:

- the opponent is right (that there is negative certitude about x), then $p3 = 1$.
- if it cannot be known whether the opponent is right, then $p3 = 0$;
- the opponent is not right; then, $p3 = -1$.

Before the general method for determining the kimsakus can be applied, one must consider some aspects of the nature of modal statements which will greatly assist in obtaining their triads.

First, it must be remembered that in a trivalent system of logic the maximum number of simple modal statements is 27, that is to say, 3^3 . In a bivalent system there are only 4, i.e., 2^2 .

Second, with the exception of the triad $(0,0,0)$, which is its own opposite, the remaining triads form 13 pairs in which each one is the opposite of another (the term "opposite" must not be confused with "antonym.")

It must also be pointed out that truth-values are equidistant from the center, which creates a certain symmetry. For instance, $(1,1,0)$ is symmetric to $(0,1,1)$. When the meanings of statements are analyzed, a certain degree of logical symmetry is also apparent with respect to the concept of "logical antonymy".

4.3.- Determination of kimsakus of asseveration

In Aymara, there are approximately twenty modal statements which are used in everyday language. It is difficult to tell whether any of the 27 triads of trivalent logic are not being used. This book concentrates on the most frequent statements, in order to determine their kimsakus. This material seems to demonstrate that Aymara logic is trivalent, and to show the strictly mathematical manner in which the logical suffixes of this language have been defined.

4.3.1.-Amodal kimsaku $x = (1,0,-1)$ (Affirmation)

This amodal kimsaku establishes the order in which comparisons will be made in this book to determine the truth-values $p1$, $p2$, and $p3$ of any modal kimsaku. Example:

$x = \text{"sarta"} (= \text{you went})$

4.3.2.-Determination of $x.wa = (1,0,-1)$ (Reliability)

The suffix "wa" emphasizes that statement x is reliable but does not involve a logical modality. It is a unit operator, which does not transform the functor.

Examples:

$x.wa = \text{"sartawa"}$

$\text{"}/\text{you}/ \text{have gone"}$

$x.wa = \text{"jumaj roanqtawa"}$

"you have eaten"

$x.wa = \text{"jumawa manqtaja"}$

$\text{"you are (the one who) has eaten"}$

The meaning added by the suffix "wa" is perfective rather than modal. The examples above show that when wa is added to the pronoun rather than to the verb, emphasis is placed on the actor rather than on the action; however, the fact that "someone has eaten" (the dictum) is not affected modally.

Comments:

(ETA-87): *"WA is the most important agglutinator, and is a constituent element in the formation of a great many phrases and sentences." "The functions of WA are equivalent to those of the verbs "to have" and "to be"; this suffix is always used at the end of a sentence."*

(MJHB-413) *"WA marks the sentence as affirmative and/or personal knowledge." "WA does not occur with the suppositional."* (quoted in English by IGR) For a better understanding of the use of the suffix wa and its relationship to the subordinating element ja, the reader is urged to consult existing Aymara grammars, since these are the most widely used and most frequently studied suffixes. However, a few grammatical aspects are unclear, since specialists cannot agree on whether these suffixes have functions equivalent to those of Spanish auxiliary-verbs.

4.3.3.-Determination of $x.pi = (1,-1,-1)$ (Certitude)

There is no doubt that this statement corresponds to the modality of logical necessity, or certitude, of classical modal logic.

Examples:

(ETA-288) $x.pi = \text{"nayapi sarayatja"}$

$\text{"yo pues (soy quien) hube ido."}$

$\text{"I for sure (it is I (who) had gone"}$

(ETA-288) $x.pi = \text{"sarayatpi"}$

$\text{"(yo) hube ido pues"}$

$\text{"(I) had gone for sure"}$

(ETA-291) $x.pi = \text{"çuraninapapi,"}$

$\text{"(él) tiene que ir a darle pues."}$

"(he) has to go give him for sure"

(HR2-102)= "aka çaułlt munta?"
"este pescado quieres?"
"do you want this fish?"
x.pi = "jisa, uka çaułpi muntja"
"si, ese pescado pues quiero"
" yes, I want that fish for sure"

(JEE-82) Kitisa?
quien es?
"who is it?"
"pedropi"
"Pedro (es) pues"
"It (is) Peter for sure"
x.pi = "akapi"
"este(es) pues"
"this (is) for sure"

These examples show that besides emphasizing perfection, pi is also a strong modal emphasizer which excludes any possibility of doubt. The suffix pi implies that the verb action is executed "without fail." The suffix "pi" can replace "wa"; when it does it also takes on its functions as an auxiliary verb (be or have). Thus, the statement x.pi is an asseveration ($p1 = 1$), which excludes the possibility of any uncertainty ($p2 = -1$) and, of course, excludes the negation ($p3 = -1$); this makes it easy to determine its kimsaku (1,-1,-1) ;

Comments:

Ebbing classified pi among the adverbs. Ross said that this suffix is the generator of the "confirmative mood"

(HR-102). *"The confirmative mood is used to confirm the truth of something suggested by the listener, or which is evident to him. The primary enclitic pi is always used with this mood."*

In the Aymarized Spanish spoken in Bolivia, especially in La Paz, the mood with the suffix pi is so common, that people end their sentences with "pss", for example: "está viniendo pss" /"he is coming PSS"/ (he is coming certainly). pi can also be followed by ni (from the auxiliary verb "have to"), forming the suffix "pini". Example: "sarjepiniwa" (ya se ha tenido que ir siempre /he has already had to leave, already/ (1). In such sentences, "siempre"/always" does not have its usual meaning; it is an idiom indicating logical necessity, certitude. The suffix "puni" is mentioned in grammars as an equivalent; however, "puni" indicates the obligation of having to do something. For example:

jutatapuni (you must come pues /for sure/)

4.3.4.-Determination of x.su = (1,1,-1) (Possibility)

This is the modality of possibility, i.e., x.su denotes "it is possible that x", or "it may be that x". The truth-table, or kimsaku of x.su corresponds to Tarski's modal function $M(x)$ (JL-75).

This modality is generated by the suffix su, often linked to the suffix indicating the listener, but not the speaker. This has had an impact on Aymaranized Spanish sentences: reflexive pronouns are very common, especially in La Paz markets.

Examples:

x.su= "alaña munasmawa"
 'pueda que te quieras comprarte'
 (pueda que quieras comprar)
 /You yourself may want to buy it for yourself/
 /You may want to buy it/

(JJE-224) x.'su = 'jupaj apaspawa uka'
 (él se podría llevar eso)
 'él podría llevar eso'
 /He himself could carry that/
 /He could carry that/

(ETA-126) x.su = 'nayawa lurirista' (using the actor)
 'yo haria'
 /I would do/

(LBO-34) x.'su = 'yatiçaspa'
 '(ojalá) aquel enseñara'
 '(Would to God) that person taught'

(LBO-35) x."su = 'yatiçanis'
 'él habria de(ir a) enseñar'
 /He would have to (go to) teach/

These examples show that this modality can be easily identified. It is an asseveration, so $p1 = 1$. However, there is an element of doubt, since the verb action is only potentially true, then $p2 = 1$; as the impossibility is excluded, $p3 = -1$: This results in the well-known triad of possibility (1,1,-1). Aymara scholars do not agree on the number of grammatical moods which can be used for the modality of possibility involving , the suffix su. In the opinion of the famous German linguist Middendorff, there are two moods: the optative and the potential. Ebbing and all those who follow Bertonio's schema of paradigms believe there is only one, which they refer to as either optative or potential. However, they are not fully convinced that the ending s which appears in those moods really corresponds to the suffix su; in some examples they suggest it corresponds to sa. When analyzing the optative mode, Bertonio himself (LBO-35) mentioned vaguely the suffixes su and cu. It should be pointed out that, in Quechua, the suffix cu is related to the concept of possibility, for example "payçusina" (I think it is him). (YSS-121).

In any case, given the logical consistency of Aymara syntax, one can chance agreeing with Middendorff that there are really two moods for the modality of possibility: the optative and the potential, and that s never corresponds to sa, because the suffix sa has a well-established logical function, completely different from that of possibility, as will be seen below. It would be the only suffix among over a hundred to have more than one logical function. This would be a remarkable inconsistency, since Aymara suffixes never produce logical homonymy. For this reason, the statement of possibility will be symbolized by x.su regardless of whether, in the translation, the Spanish optative, potential, or Subjunctive moods are required. To reassure the demanding reader who might find the above classification of the suffix su arbitrary, I must say in advance that the mathematical analysis of Aymara logic proves that the suffixes sa and su have different well-defined algebraic characteristics.

Comments:

(E4JM-198) "*Vom Optativ: Dieser Modus verdient in der Tat seinen Namen, da seine Formen, ohne weitere Zusätze, wie z.B. in unserer Sprache, 'wenn doch, ich möchte', den Wunsch ausdrücken*". (About the Optative: This mood really deserves its name, because its forms, without any additions, express desire, for example, in our language /German/:

"if it is so, I would like to."

(EWM-198) "Der Optativ steht in Konditionalsätzen, wenn die Bedingung wohl als möglich, aber nicht als wahrscheinlich gedacht wird, oder wenn deren Erfüllung überhaupt unmöglich ist, da sie in der vergangenen Zeit hätte stattfinden müssen." (The Optative appears in conditional sentences when the condition is considered to be possible, but not probable, or when its fulfilment is totally impossible, because it should have happened in the past.)

(EWM-199) "Der Optativ steht in Konzessivsätzen, in welche etwas Mögliches oder auch Unmögliches eingeräumt wird" (The Optative appears in concessive sentences, in which it is admitted that something can be both possible as well as impossible)

(EWM-199) "Vom Konditional: Dieser Modus kommt in schatz der Bedingungsätze zur Anwendung, in welchen ausgesagt wird, was geschehen sein würde, wenn die im Vordersatz ausgedrückten möglichen oder unmöglichen Bedingungen erfüllt worden wären. (About the Conditional /IGR adds "Potential" in Spanish/: this mood appears in the post-statement in conditional sentences, in which one indicates what would have happened, should the possible or impossible conditions expressed in the ante-statement have occurred."

4.3.5.-Determination of $x.ki = (1,0,0)$ (Likelihood)

This modality has no equivalent in other languages. It is typically Aymara, and it is a key element in the psychology of the Altiplano Aymara-thinking people who have altered the meaning of the Spanish word "nomás", to try to express the modality generated by the suffix "ki". "nomás" is used at the end of the sentence, to indicate "probably."

Examples:

(ETA-219) $x.ki =$ 'sañaki'
'decir nomás'
'Say probably/'

(ETA-225) $x.ki =$ 'luranikiwa'
'he de ir a hacer nomás'
'I must go do it probably/'

$x.ki$ practically means "it is probable that x "; therefore, the best technical name for this modality may be "likelihood."

It is a sentence in which the speaker expresses his good will, but without committing himself, because he is not certain of its impossibility. It does not even indicate doubt. Therefore, since it is an assertion, $p1 = 1$. However, the other two cases are doubtful, thus, $p2 = 0$, and $p3 = 0$. So, its kimsaku is $(1,0,0)$.

The suffix "ki" might be called the suffix of "Aymara possibility", which differs from classical or conditional possibility in one respect: the uncertainty concerning doubt is left open ($p2 = 0$). As was pointed out in Section 4.3.4, the suffix "su" indicates conditional possibility, in which there is some doubt ($p2 = 1$). It is not by pure chance that the suffix ki appears in the core of the word "waki" (possible). Thus, we have the following verbs:

- wakisiña ("serse" posible) /idiomatic for "to be possible"/
- wakisiyaña (to become possible = can)

For example:

(LB2-148) sarañama wakisiwa(it is possible that you leave)
saraña wakisiyatawa (you may leave)

In his grammar, Bertonio has explained very well the subtle difference between these two closely related verbs:
(LBO-106-108) "The first manner (wakisiña) involves possibility or impossibility due to an extrinsic factor, such as

illness or some other kind of impediment; the second (wakisiyaña) involves possibility or impossibility, either intrinsic or voluntary."

Although Bertonio explained very clearly the peculiarities of the verb "possum", both in his grammar and in his dictionary, modern grammars do not use it to translate "can". They use only the verb "yatisiña" (to be used to). This is because in Spanish "poder" is a synonym of "force" or "power" and implies certainty that something will be done, whereas the Aymara verb "wakisiyaña" implies the carrying out of a possibility. In the words "wakisiña" and "wakisiyaña", both verbs are made reflexive by the suffix "si". In Spanish the verb "can" is not reflexive; nevertheless, Aymara-thinking people who speak Spanish use it as a reflexive verb, producing sentences such as:

'te puedes pegarme si quieres, igual no te obedeceré.'
/You can yourself hit me; I won't obey all the name/

and:

'me puedo peinarme'
/to myself I can comb my hair/

The verb wakisiyaña (to become possible = can) must not be confused with the verb "wakiña" to which the suffix "cha" can be added to express "to make possible" or "to facilitate".

Ludovico Bertonio understood the concept of "limited" affirmation involved in the statement x.ki; thus, in his Spanish translation he used the term "ni otra cosa más" /not another thing/, or "solamente" /only/, which later became "no más" /no more/; the word "no más" did not fully convey the meaning of limitation in the statement, so the idiom "nomás" appeared at the end of sentences, see (LBO-291).

Evidently, the word "only" is close to the sense of likelihood. For example, "estará cansado solamente" /He will only be tired/ is equivalent to "it is likely that He will be tired" (and not something else). However, the word "solamente" may have a different connotation in Spanish and imply exclusiveness.

Some translators of religious materials have interpreted the suffix *ki* this way, and have produced sentences like: "ma Diosaki utijja" when they meant to say "there is only one God"; in fact, they were saying "it is likely there is a God", or, in the popular variety of Spanish spoken in this region: "hay un Dios nomás" /there is a God, probably/

Comments:

(ETA-225) "*ki*" expresses decision and urgency in an immediate action; it also denotes avoidance of responsibility, or satisfaction of a desire, or interest.

(ETA-219) "*ki*" is equivalent to the adverb "nomás" (a Bolivian idiom without negative meaning) which generally indicates sufficiency, enough, continuity, or plea."

This quote shows that Tarifa thinks according to a trivalent system of logic, because he states specifically that this suffix has no negative meaning; someone who thought according to a bivalent system of logic would simply have said "affirmation", because if it is not a negation, then it is necessarily an affirmation. However, as we have seen, for a trivalent mind there are many possibilities. Evidently, x.ki is a weak assertion indicating a doubt about its impossibility, but without openly expressing doubt; thus, the value of p_2 is not 1, as with the statements of doubt and plausibility.

(HRI-45) "*ki*" in imperative forms of the verb indicates encouragement" /quoted in English by IGR/. Ross gives a typical example of this use: 'saraskakim' ('esté yendo nomás' /you may go/ /go ahead/.)

4.3.6.-Determination of x.ka = (1,-1,0) (Evidence)

The suffix "/ka" is usually combined with other suffixes. It is used alone in present tense (gerund) and compound statements. Grammar textbooks rarely discuss its logical function when it stands alone.

Examples:

(IIM-G7) 'jumaj sarkam ançičaw nayaj jiktanim'
x.ka = 'Tú estate yendo, yo ahorita ya te alcanzaré'
/You may go; I'll catch up with you/

(IIM-G7) 'niyaw aymar yateqkta.'
x.ka = 'ya estoy aprendiendo aymara'
/I am already learning Aymara

(LBO-270) 'mandkaña'
x.ka = 'estar comiendo'
'to be eating'

(LBO-270) 'misskaña'
x.ka = 'estar diciendo misa'
/to be saying mass"

In this modal notion there is some evidence that the statement is true. This is the difference between the modal notions of Potential and Evidence. Thus, in compound statements, the modality of evidence is taken as a condition for a second potential statement involving the conditional. Then, $p_2 = 1$. However, the modality of evidence differs from the modal notion of necessity, in that no clear position is taken as to the impossibility of the statement; some doubt remains about the truthfulness of the statement, because it is in the process of being completed. Thus, $p_3 = 0$. Of course, it is also an asseveration, so $p_1 = 1$. The kimsaku for this modal notion is, therefore, $(1, -1, 0)$. The suffix "/ka" can best be translated into Spanish using the gerund ("-ando" and "-iendo" /Eng. "-ing"/). That is why this modality is also called "gerundive". In fact, the truth-value of:

- "it is evident that he comes"

is equivalent to:

- "he is coming"

By this time, the reader will have realized that it is useless to seek analogies between the moods of Spanish grammar and the modalities of trivalent logic. There is no such problem in Aymara, because the meaning of each suffix is precisely defined in the triads. If they are used properly, there are practically as many moods as there are modalities.

In Spanish, there are only three officially recognized moods: the Indicative, the Subjunctive, and the Imperative. [\(2\)](#)

The Potential (which in the last few years has also been called Conditional) is not considered a mood. This is due to disagreement between logicians and grammarians, who tend more towards general definitions. To the reader who adhere to the rules of the Spanish Academy, this author would like to apologize for the somewhat arbitrary use of the word "mood" when referring to Aymara modal notions; however, this seems to be the best way to translate the subtleties resulting from this fine modal differentiation.

4.3.7.-Determination of x.ska = $(1, 1, 0)$ (Feasibility)

This is a very interesting modality, because it shows very clearly how well the genial creators of the Aymara language understood the implications of logic for the temporal aspect of statements. The suffix "ska is made up of the suffixes su and /ka (the u is elided); it is used to form the "potential gerund", i.e., it indicates that the verb action would be occurring at this moment.

Examples:

x.ska = 'manqaskatwa'
(I) 'would be eating'

x.ska = 'laruskta'
'(you) would be laughing'

Both x.ka and x.ska involve a gerund, which affects the logical meaning of the statement.

From a strictly logical standpoint, it is evident that "/He/would be eating" means the same as "/He/ has almost eaten". Obviously, this is an asseveration: $p1 = 1$. However, there is some doubt as to completion of the action, since the person may choke, and the activity could cease without having been terminated; then, $p2 = 1$. Now, if the person has not eaten, it cannot be deduced whether he has or has not been eating; therefore, $p3 = 0$. This modality can be called "feasibility" or "gerundive possibility". Thus, we see that x.ska = (1,1,0).

The Greeks also understood the close relationship between the time an action occurs and the modal notion of possibility. Diodorus Cronus (died in 307 BC), a disciple of Eucleides of Megara, questioned the concept of possibility, and reformulated it as a temporal variable, saying "it is possible in time t" (JFM). The Qoyas have no such problem; their syntax includes suffixes for both concepts of possibility: one involves the suffix su; and the other a combination of su and /ka, which makes the possibility gerundive.

ska is a compound suffix; this makes it possible to test the validity of the triads given in this book for su and /ka. It stands to reason that x.ska is (x.'su).ka; in other words, it is the result of adding first the suffix su, and then the suffix /ka to the statement x.su. This is one of the many verifications presented in the next chapter; however, we can say in advance that the results are conclusive; the way each and every compound logical suffix is used in Aymara is highly consistent with the logical analysis of each statement.

The notion of feasibility x.ska may become the notion of possibility if the indetermination about that which is uncertain can be eliminated assuming that if the verb action is not completed the statement cannot come true; then, $p3$ becomes -1, and the triad is that of x.su. This can be done simply by adding the suffix of the modality of necessity:

x.'ska.pi = 'manqaskatapi'
'estarías comiendo pues'
'/you would be eating for sure/

In a strictly mathematical-operational way, it can also be proven that x.ska.pi s x.su; in other words, both statements are logical synonyms and have the same kimsaku (1,1,-1).

In Aymara:

"it is possible that x" = "it is certainly feasible that x."

4.3.8.-Summary of the modalities of asseveration

The determination of the kimsakus of asseverative state ments has led to the identification of 6 different modalities(sic); these notions are all similar in that always $p1 = 1$, and $p3$ is not -1.

The following table is a summary of all these notions. The Spanish forms used to translate the Aymara modalities of asseveration are also listed.

MODAL NOTIONS OF ASSEVERATION IN THE AYMARA LANGUAGE

Asseveration	Opposite	Antonym
$x = (1,0,-1)$	$-x = (-1,0,1)$	$x = (-1,0,1)$
'affirmative that x'	'negative that x'	'affirmative that not -x'
$x.wa = (1,0,-1)$	$x.ka.ti = (-1,0,1)$	$x.ka.ti = (-1,0,1)$
'reliable that x'	'false that x'	'reliable that not -x'
$x.pi = (1,-1,-1)$	$x.pi.ka.ti = (-1,1,1)$	$x.sa.pi = (-1,-1,1)$
'certain that x'	'uncertain that x'	'certain that not -x'
$x.su = (1,1,-1)$	$x.ska.ti = (-1,-1,1)$	$x.ki.ti = (-1,1,1)$
'possible that x'	'impossible that x'	'possible that not -x'
$k.ki = (1,0,0)$	$x.ki.ka.ti = (-1,0,0)$	$x.ka.ti.ti = (0,0,1)$
'likely that x'	'unlikely that x'	'likely that not -x'
$x.ka = (1,-1,0)$	$x.ka.ka.ti = (-1,1,0)$	$x.ti.ti = (0,-1,1)$
'evidence that x'	'not evident that x'	'evident that not -x'
$x.ska = (1,1,0)$	$x.su.la = (-1,-1,0)$	$x.la.ska = (0,1,1)$
'feasible that x'	'not feasible that x'	'feasible that not -x'

Modal notions of assertion in Aymara

- $x.la.cha = (1,1,1)$ Tautology
- $x.la.pi = (-1,-1,-1)$ Contradiction
- $x.la.la = (0,0,0)$ 'Abdiction' /the author might mean 'abduction'/ [\(3\)](#)

4.4.-Determination of the kimsakus of queries

The negation of a statement is not always its antonym; this is particularly true of amodal statements. This fact was recognized by classical logicians, who introduced the concept of partial negation -the negation of only the modus-, and who established a difference between this and the negation of the whole statement. In modal symbolic logic this depends on the order in which the negation is applied to the modal operator.

For example:

Original Statement	Opposite Statement	Antonymous Statement
$x = \text{'he comes'}$	$N(x) = \text{'he does not come'}$	$N(x) = \text{'he does not come'}$

(1,0,-1)	(-1,0,1)	(-1,0,1)
$M(x)$ = 'he may come' (1,1,-1)	$N(M(x))$ = 'it is impossible he may come' (-1,-1,1)	$N(M(x))$ = 'it is possible he may not come' (-1,1,1)
$G(x)$ = 'he certainly is coming' (1,-1,-1)	$N(G(x))$ = 'it is uncertain whether he may come' (-1,1,1)	GNx = 'he certainly does not come' (-1,-1,1)

This Table shows that the opposite and the antonym of an amodal statement are identical.

These examples also show a well-known fact of modal logic: the opposite of the notion of possibility is identical to the antonym of the notion of certitude. Using Aymara suffixes:

$-x. su = (-x).pi$

it is impossible that x s 'it is true that not x'

The adverb "not" plays an ambiguous role; it is used both to form the opposite and the antonym of the statement. To solve this ambiguity, one must use auxiliary verbs such as "ser posible que" /may/, and "ser necesario que" /must/, or their idiomatic equivalents. (4) So, rather than saying "possibly he will not come", and "not possibly he will come", one must say "it is possible that he will not come" and "it is not possible that he will come."

However, when modal statements more subtle than those of certitude and possibility are involved, for example, queries, the adverb "not" is inadequate for a consistent treatment of opposite and antonymous statements. To make the language of symbolic logic compatible with everyday language, the same statements must be generated by resorting to idiomatic forms unsuitable for conversation or for making inferences about practical problems, which is another disadvantage. The difficulties associated with auxiliary verbs are foreign to Aymara, since suffixes, which are easy to apply are used instead. Aymara has a very elegant way of distinguishing an opposite from an antonym: the negation does not involve one suffix, but two. So, it is not necessary for modal statements to consist of two parts (modus and dictum), although both concepts are implicit in the strings which make up the statement. Thus, the formulae of Aymara symbolic logic are totally compatible with the corresponding idiomatic expressions of the language.

At this point, a distinction must be made between Question and query. A question is a sentence which asks for an explanation, or requests some information. One does not answer a question simply by saying yes or no; a complete answer must be given. However, a query is a sentence which demands an answer involving a truth-value.

For example, "Why have you come?" is a question, whereas "By any chance, have you come?" is a query.

The above definitions for the words "question" and "query" are somewhat arbitrary, but useful for our research. It is necessary to distinguish between these words and to determine their specific meanings because a question cannot have a truth-value, and, therefore, is not a logical statement.

Queries are definitely logical statements, because they can be related to their respective amodal statement, from which its triad of truth-values can be deduced. In Aymara, the suffix ti indicates that a statement is a query; this suffix is never used with questions, as they do not fall within the schema of modal statements. In questions, suffixes such as sa and ja are used, which is a different type of syntactic algorithm.

Examples:

$x.ti =$	'lurtati?'
	'acaso has hecho?'

	/By any chance, have you done it
x.ti=	'sarjeti?'
	'acaso ya se ha ido (él)?'
	/By any chance is (he) already gone?/

Each of these modal statements can be compared with its amodal statement, which can be obtained by using wa rather than ti. That is to say, to obtain their kimsakus, the question 'lurtati?' must be compared with its amodal statement 'lurtawa' (you have done).

When a proponent says "he is gone" and the opponent queries "by any chance, is he already gone?", the opponent's statement must be interpreted as an opinion regarding the statement of the proponent (who has used factual language). It can be noticed immediately that this is an assymetric query by comparing it with its antonym, "by any chance, is he not gone yet?". In the first case, we query that he is gone, in the second case, that he is not gone, in other words, when one queries, one is making a statement.

4.4.1.-Determination of x.ti = (-1,1,0) (Positive Controversy)

In Aymara, when the suffix ti is used to query the veracity of the amodal statement, the statement is not expected to be true. In the interrogative statement "acaso ya se ha ido?" /by any chance is he already gone?/ an affirmative answer is not expected. If the answer is "yes, he is already gone", the query has been erroneous. So, for the statement x.ti, $p1 = -1$. Now, since the statement involves doubt, $p2$ must be = 1, because factual in-certitude only serves to justify the use of the interrogative. If the factual statement is not true, it cannot be known whether the query was correct or not, because no doubt was involved, nor was it considered, so $p3 = 0$.

The suffix "ti" implies a controversy and insinuates that the statement may not be true; therefore, it can best be translated into Spanish using the idiom "acaso". This modal notion corresponds to the Spanish interrogative form (5).

Thus,

x.ti = 'manqtati?'
 'has comido acaso?'
 /have you eaten by any chance (6)/

"Ti" sometimes cannot be translated by "acaso", particularly when combined with other suffixes; then it is translated using the idiom "siempre". (6)

The examples will show the proper way these Bolivian modisms must be used to accurately translate the logical meaning of queries from Aymara into Spanish.

Care should be taken when using this modal notion of controversy to avoid asking impertinent questions; this modality is only appropriate when it is very probable that a negative answer will be given. If it is known that someone has done something, one should not ask "acaso has hecho tú?" / 'by any chance have you done...?' / as this would imply doubt that he has done it, and would be a concealed way of expressing a negative opinion, In Aymara, this kind of question is called "jiskiçukiña" (to ask questions under false pretense); this word is composed of the nucleus "jiski" (question) and the infix of psychological simulation, "çuki".

However, if somebody is accused of having committed an act such as murder, the lawyer should ask "jiwaytati?" ("acaso has matado?") /by any chance, have you killed?/; this indicates a certain degree of trust, because although there is some doubt, an affirmative answer is not expected from the accused.

The formal statement for suffix "ti" is: x.ti = "it is controversial that x".

Negative exhortations: $x.ti = (-1,1,0)$

Negative exhortation is a type of negative statement which is the opposite not of statements of affirmation, but rather of statements of evidence. An exhortation such as: $p = 'jan llullämti'$ ('you shall not deceive') does not deny the fact that "you have deceived", but implies rather that "you should not deceive in the future". If the exhortation is not effective, i.e., if you do deceive, the exhortation is obviously a failure; so, for $x = 1, p = 1$. When there is some doubt whether you "have deceived", the exhortation is proven to be valid, since otherwise it would not have been necessary; if one exhorts it is because the possibility exists that you "will deceive"; thus, for $x = 0, p = 1$. If the exhortation was effective, i.e., if you have not deceived, one can not be sure whether the exhortation was necessary because without it you "might still not have deceived." This last possibility remains open in the modal notion of exhortation; thus, for $x = 1, p = 0$.

Therefore, the kimsaku of statements of negative exhortation is $(-1\ 1\ 0)$, which is the kimsaku of the suffix "ti". In fact, in Aymara this kind of negation is generated by adding only the suffix "ti"; the suffix "/ka" is not used at all, which differentiates this kind of statement from the negation of affirmative statements, i.e., $x.ka.ti = janiw llullktati'$ (you have not deceived).

The classical principles of Qoya ethics are good examples of this kind of statement:

- $x.ti = 'jan llullämti'$ (thou shalt not deceive)
- $x.ti = 'jan karisimti'$ (thou shalt not lie /to yourself/)
- $x.ti = 'jan jayrämti'$ (thou shalt not be lazy)

It is interesting to note that in Aymara the verb "to lie" is reflexive (karisiña). The verb "mentirse" /to lie to oneself/ implies that when all is said and done, he who lies (to others) is really lying to himself. Thus, in the popular variety of Spanish spoken in the Altiplano, rather than saying "ha mentido"/he has lied/ people say "se ha mentido"/he has lied to himself/. A "karisiri" (a liar) is a person who is really deceiving himself by not always telling the truth. Other words are used when someone does not tell the truth, but is not "lying" /to oneself/; for example, "kauka" (pranks, practical jokes, as a child would do.) (NFN-39).

The first scholars who studied Aymara were very interested in the form of negation of negative exhortations, because of its importance for religious preaching. Since in Spanish the adverb "not" plays an ambiguous role, early grammars say that the negation is generated by adding only the suffix "ti"; the suffix "/ka" is not mentioned, although it appears in some illustrative examples. Garcia was the first to notice this remarkable feature of Aymara (JAG).

4.4.2.-Determination of $x.ka.ti = (-1,0,1)$ (Negation: it is false that x)

Examples:

$x.wa =$	'jutapjewa' (they) have come
$x.ka.ti =$	'janiwa jutapjkiti' (they) have not come
$x.wa =$	'jutapjayatwa' we (my people) came
$x.ka.ti =$	'janiwa jutapjakayatti' we (my people) did not come
$x.wa =$	'umaj muntwa' /I/ want /some/ water (the ater I want)

x.ka.ti =	'janiw umaj munktti' I want no water 'janiw umaj munk <u>tati</u> ' /you want no water/
x.wa =	'umaj utji' There is /some/ water
x.ka.ti =	'janiw umaj utjkiti' there is no water

In Aymara, the negation does not play a key role as it does in Spanish. Negation is just one of the modal notions, which might be classified as a query, since formally:

'it is false that x' = 'it is controversial that it is evident that x'

In the third person of the present tense, the suffixes which generate the negation become "kiti" because of elisions; thus, care should be taken to avoid confusion. Apparently, Ludovico Bertonio did not understand this point very well; in his grammar he stated that both the negation and the interrogation [question] are formed simply by adding ti. Fortunately, he realized, especially in his later dictionary (LB1-335), that the suffixes /ka and ti are both involved in any negation of amodal statements. The formation of negative statements in Aymara is well established in modern grammars; however, it is not always clearly explained that the k appearing in negative statements always belongs to the suffix "/ka"; this is because of the lack of a syntactic model, among other things. The determination of the triad for the negation is more than obvious; if the factual statement is true, its denial is a mistake ($p1 = -1$); if the factual statement is uncertain, its denial does not remove the doubt ($p2 = 0$); and if the factual statement is not true, the negation is correct ($p3 = 1$). Thus, x.ka.ti - x.wa, as was expected.

Comment:

(JEE-127) *"the following is important: in the affirmative form one says "naya munayata" and "naya laruyata"; the vowels 'a' in muna and 'u' in laru are not dropped because they are part of the root; however, in the negative form one says "munkayati" and "larkayati", because the same ending is used after mun and lar.*

4.4.3.-Determination of x.ti.ka = (0,1,-1) (Negative Controversy)

This kind of statement also implies controversy, the only difference being that it is symmetric with or the antonym of x.ti.

Examples:

x.ti.ka = 'janiti lurarapkatapaja?'
'acaso no se lo estás haciendo?'
/By any chance you are not doing it to him?/

x.ti.ka = 'jumati lurarapkatapaja?'
'acaso tu siempre se lo estás haciendo?'
/By any chance are you always doing it to him?/

It is evident that one expects confirmation rather than a negative answer to these questions. If a negative answer is given, one has made a mistake, and is surprised because a negative answer was not expected. That is to say, for this modal notion, $p3 = -1$. Obviously, the same reasons apply in this case, but only in a symmetrical manner, $p2 = 1$ (there is doubt), and $p1 = 0$; thus, the kimsaku is (0,1,-1).

A prosecutor would be making a mistake if he asked a defendant "janit jiwaykataja" /By any chance, you would not have killed him?/; he would be assuming the answer would not be negative, when it is factually evident that the defendant "has not killed."

This modal notion shows that suffixes ti and /ka play different roles depending on the order in which they are used. This will be proven mathematically by demonstrating that they are non-commutative operators.

This statement can also be formulated positively if the pronoun rather than the adverb of negation is used to translate the suffix ti:

x.ti.ka = 'jumati lurkataja?"
'acaso tú siempre estás haciendo?'
/By any chance, are you always doing/it/?/

This example also shows that a negative answer is not expected, because this statement implies a controversy, and leaves open the possibility that what is implied by the question will not prove true.

4.4.4.-Determination of x.sa = (0,0,1) (Adversative) (7)

Modern grammars do not distinguish between sa and the possessive suffix sa, which was spelled ssa in early grammars. This is because the phonetic difference is very slight. However, the functions of both suffixes differ widely so that it is advisable to use the letters s and ss to avoid confusing them when one follows immediately upon the other, as happens when logical operators in class "I" are linked to the suffixes indicating the recipient, or possession, as the case may be. For example, a distinction should be made between these two suffixes in sentences like 'apirissa' (ni nuestro portador /not even our porter (8)/) (ETA-82).

Examples:

(ETA-81) x.sa = 'utamaj jayawa, jaypurusa purkáss'
'(la) tu casa es distante, (él) ni a la tarde estará llegando'
/(the) your house is far; (he) not even in the afternoon will be arriving/

(ETA-81) x.sa= 'lurañamasa'
'ni en el hacer'
not even in the making/

(ETA-83) x.sa = 'alasiñamasa poqatakäniti'
'ni lo que compres ha de estar completo'
/not even what you buy will be complete/

(ETA-90) x.sa = 'janisa'
'aunque no' (ni no...)
/although not/ /not even not.../

The logical content of statement x.sa shows immediately that this is an adversative modality and indicates negative conjunction; thus, $p_3=1$, because it affirms non-fulfilment of x. However, values p_1 and p_2 cannot be easily deduced from the statement itself. The statement does not involve any doubt, so p_2 can only be 0 or -1. The statement is not symmetric, so p_1 can not be 1. Thus, there are only four possible triads that can correspond to x.sa, viz, (-1,0,1), (-1,-1,1), (0,0,1), and (0,-1,1). Obviously the first one (negation) and the second one (impossibility) are out of the question, because they do not convey the logical meaning implicit in the statement x.sa. Thus, there are only two triads remaining that may correspond to this statement. Both are very similar; the only difference between them lies

in how they treat the doubt. Kimsaku (0,-1,1) is the antonym of (1,-1,0), which corresponds to x.ka, i.e., a "strong adversative" which formally means "it is evident that not-x." Thus, the kimsaku for x.sa must be (0,0,1).

Comments:

(LBO-245) "Adversative conjunction are those conjunctions such as "quanque", "uamuis", "licet" (Latin words meaning although, though) and other similar ones which correspond to particles pañā and sa, used together, as in the following example: "although you may confess all your sins, if you do not wish to mend your ways, your confession will be worth nothing" = "pañā taqe jočanakama confessasisina, jani wanija sasinka, kasikiwa confesasirikta, vel confesasiwuima hani jakurikiti". "Even if the damned weep incessantly, the devil will have no pity" = 'pañā manqepaçankkirinaka kunasa wararirikiçeja', supayonaka jani katasa kuya payrikiti'. "Etiam (another example in Latin) si me iccideris in te sperabo, = 'pañā jikuyutasma juroaki ullasimama'. So, this particle is not necessary with the nominative gerund, nor is it used when there are different assumptions using the Subjunctive and the Optative; instead of "pana" one can use "sa", for example, "confesasinsa, vel confesasimansa" = "even if you confessed" ; and instead of "sa", one can use "spalla".

Although the logic of these paragraphs by Bertonio is not remarkable, one can at least be certain that the learned linguist gave a great deal of thought to the logical meaning of "sa" and "spalla" and identified them as adversative suffixes, as they were extremely useful in his religious mission. It should be noted that he mentions the compound suffix "spalla", which demonstrates the existence of a logical suffix "lla", which is no longer used, and is not recorded in any modern grammars, with the exception of (FMS).

One of the examples given by Torres Rubio illustrates how the Qoya people have, like their language, remained stubbornly unchanging until now:

(DTR-53) "I shall not say it, even if you kill me." = "pañasa jiwawuasina jani atamasanti."

Neither the suffix "lla" nor the word "pañā" are recorded in modern grammars. Tarifa translates the suffix "sa" using the adversative conjunction "ni"/neither/ and the compound suffix "saya" by the adversative conjunction "aunque" /although/; he also sometimes uses the word "siquiera" / even if or though/, as can be seen in his chapter on conjunctions (ETA-416).

4.4.5.-Determination of x.lla = (-1,0,0) (Improbability)

This suffix is very difficult to study because there is a lack of reference material. Sanjines' is the only modern grammar in which it is recorded (FMS-42). Apparently, in present-day Aymara the suffix "lla" is pronounced "ya" (not to be confused with the infix "ya") especially in the compound form "saya" which was previously written "salla". However, there is evidence that it is still pronounced "lla", especially in the Oruro regions.

Examples:

(FMS-42) x.lla =	'uicawalla'	(alli tampoco será) /it won't be there either/
(FMS-42) x.lla =	'ukjamalla'	(tampoco será así) /it won't be so either/
x.lla =	'juttalla'	(tampoco será que viniste) /it isn't likely that you came either/

Of course, the analysis of connective statements will demonstrate that the modality generated by "lla" plays the role of an adversative connective, rendered in the local variety of Spanish as "tampoco será que"/ it is not likely either that./ The formal interpretation of this modality is: 'it is improbable that x'. In fact, this modality is the opposite of x.ki; in other words, it means "it is unlikely that x"; thus, its kimsaku can be equated with the kimsaku for "-x.ki", viz, (-1,0,0).

$x.lla$ is the equivalent of $x.pi.lla$ which, in formal language, means: 'it is improbable that necessarily x .' (LBO-328).

There is an apparent contradiction which must be pointed out: when the suffixes "lla" (improbability) and "sa" (adversative) (9) are combined to form "salla", the meaning of the modal statement generated by the compound suffix is favourable. For example:

$x.salla$ = 'mantapsalla' (que pase nomás)
/he may come in/

However, the effect of this combination can be explained by the following modal theorem:

'favourable that x ' = 'unfavourable that it is adversative that x ' (9)

Using the algebraic method explained below, it can be demonstrated unequivocally that:

- $(x.sa).lla = (0,0,-1)$

This kimsaku corresponds closely to the statement "it is favorable that x ." Some linguists (HRI, HR2) have agreed with this interpretation of the compound suffix "salla" and have called those statements concessive mode /or "mood"/.

The following modal theorems are also valid:

- $x.salla = -x.sa$

that is to say,

- "it is favorable that x " = "it is not adversative that x ." (9)

and

- $x.salla = (-x).lla$

that is to say:

- "it is favourable that x " = "it is unfavorable that not x "

4.4.6.-Determination of $x.sti = (1,1,-1)$ (Positive Eventuality)

Suffix "sti" is made up of sa and ti, in other words, $x.sti = x.sa.ti$; however, the mere analysis of sentences in which these prefixes are used cannot demonstrate this fact, because the compound suffix is never broken down into its two simple suffixes. This is only natural, since both logical suffixes belong to the syntactic category L. In section 4.7 an algebraic analysis will demonstrate that the suffix sti is indeed composed in this roanner.

The suffix sti is used in statements which can be considered queries. This is a positive manner of asking questions, to which a "yes" is expected rather than a negative reply.

Examples:

$x.sti$ =	'jumawa karistast <i>sti</i> ?' 'y t <i>ú</i> (te) has mentido entonces?' 'and you have lied (to yourself) then?/'
-----------	--

x.sti =	'jumaraki sarjatasti?' 'y también tú ya te irás?' /and will you also leave?/
x.sti =	'nayasti?' 'y yo?' /and me?/

This last question "and me?" is typical of a child who wants to know whether he can also go to a party. An answer such as "of course!", would confirm his expectations; whereas should the answer "no!" would be disappointed.

The examples show that the person asking the question is right when the factual statement is true, thus, $p1 = 1$. As there is a doubt, $p2 = 1$. A negative factual situation is not expected in this kind of question, so $p3 = -1$.

In the colloquial variety of Spanish spoken in the La Paz region the conjunction "y" /and/ is used to translate questions of the type x.sti into Spanish, to differentiate them from questions using x.ti. The conjunction "y" /and/ is not really appropriate for simple statements because it is a connective. However, in a certain sense, there is some psychological justification, because the person asking the question expects an affirmative answer and this way of asking demands a second statement in conjunction with(sic) his query to verify the possibility it implies.

This can be clearly seen in some of Tarifa's examples:

(ETA-307)	'jumaj kunraki luratasti?' (y tú qué has de hacer también?) /and what will you do, too?/
(ETA-308)	'kitimpiraki alayanipjasti?' (y con quién también hemos de ir a hacer compras?) /and with whom will we also go shopping?/

Obviously, these are not queries, but questions, which demand a detailed explanation; however, from the point of view of logic, their aim is to verify the positive truth-value of the factual statement.

It is easy to see that both x.sti and x.su have the same kimsaku. This means that the interrogative statement x.sti and the statement of possibility are logical synonyms. Therefore, the corresponding formal statement is "it is eventual that x."

4.4.7.-Determination of x.ti.sti = (-1,1,1) (Negative Eventuality)

This statement is the antonym of x.sti ; accordingly, the triads for both statements are symmetrical. That is to say, the person who asks does not expect an affirmative answer, but does expect a negative one.

Examples:

x.ti.sti =	'jumaj janit jiwaptasti?' 'no siempre has matado?' /you have not always killed/
x.ti.sti =	'jumatj jawaytasti?' 'y tú siempre has matado acaso?'

	/and you have always killed by any chance?/
(ETA-313) x.ti.sti =	'nayati laruyasti?' 'y yo he de hacer reir acaso?' 'and me, moust I make you laugh by any chance?'

Note that this query can have both an affirmative and a negative formulation. In any event, doubt is implied, so, $p2 = 1$. An affirmative answer is not expected, therefore, $p1 = -1$. However, since a negative answer is expected, $p3 = 1$.

To show the logical implication of these interrogative statements in translation, one must again resort to Bolivianisms such as "acasó" /by any chance/; the lengthening of and stress on the final vowel of this word conveys doubt about the "yes". The word "siempre" /always/ is used to translate positive statements. For negative statements, it is sufficient to use "y" /and/, as shown by the innumerable examples. in Tarifa's grammar.

The counsel for the defense, when asking his client whether he has killed or not, must use this kind of interrogative statement, because it conveys his belief that his client has committed no crime, even if there is some doubt.

AYMARA MODALITIES OF QUERY		
Query	Opposite	Antonym
$x.ka.ti = (-1,0,1)$ false that x	$x.wa = (1,0,-1)$ reliable that x	$x = (1,0,-1)$ false that not -x
$x.ti = (-1,1,0)$ controversial that x	$x.ka=(0,1,-1)$ evident that x	$x.ti.ka= (0,1,-1)$ controversial that not -x
$x.sa = (0,0,1)$ adversative that x (10)	$x.sa.lla = (0,0,-1)$ granted that x	$x.la.sa = (1,0,0)$ adversative that not -x
$x.lla = (-1,0,0)$ unfavorable that x	$x.ki = (1,0,0)$ favorable that x	$x.sa.lla = (0,0,-1)$ unfavorable that not -x
$x.sti=(1,1,-1)$ eventual that x	$x.sti.ka.ti = (-1,-1,1)$ not eventual that x	$x.ti.sti = (-1,1,1)$ eventual that not -x

Note:

- modalities
- $x.ka.ti$
- $x.lla$
- $x.sa$

Do not demand an answer, thus, they are modalities of impugnation / refutation / rather than queries.

4.5.-Determination of kimsakus of conjecture

The modus(sic) of pure and symmetric doubt is governed by the suffix ci. As this suffix has no equivalent in other languages, it is difficult to explain and understand in translation, which can perforce only be an approximation.

Once again, one must resort to Bolivian idioms For the translation of an Aymara suffix. Tarifa's examples throw light on the meaning and uses of the suffix *çi*; this scholar from Pacajes deftly interpreted these Bolivianisms.

4.5.1.-Determination of $x.çi = (0,1,0)$ Contingency (Symmetric doubt)

Examples:

(ETA-274)	x.çi=	'ukakiçiya' 'quizás es pues eso nomás' /perhaps it is PUES that NOMAS/
(ETA-274)	x.çi=	'aka qerunakaj nayatakiçini' 'esas maderas quizás sean pues para mi' /those planks maybe are for me PUES/
(ETA-274)	x.çi=	'janiwa yatkti, uruçi arumaçi' kunapaçapuniya luntataj utaru mantçi, tage qepsu1nkama' 'no sé; habrá sido de día o de noche; cuando siempre se habra entrado el ladrón a la casa, hasta cargar con todo.' /I don't know; it might have been either day or night; when SIEMPRE the thief might have himself broken in the house and stolen everything./
(ETA-275)	x.çi=	'uñjañaçiya' 'habrá que ver pues' /it must be seen PUES/
(ETA-275)	x.çi=	'luririçi' 'sabrà pues (él) hacer' /he will know how to do it/
(ETA-275)	x.çi=	'sarçiñaniya' 'quizás pues iremos' /Maybe we'll go PUES/
(ETA-277)	x.çi=	'nayaya sarçi, jani jutani ukaj' 'quizás yo pues iré, si no ha de venir' /Maybe I will go PUES, if he is not going to come/
(JEE-123)	x.çi=	'inaj jupa munçi' 'tal vez él quiera' /Maybe he may want to/
(JEE-124)	x.çi=	'inaj juma munçita' 'tal vez tu quisieses' /Maybe you would want to/
(EWM-149)	x.çi=	'istçita' 'vielleicht hast Dugehört'

		/Maybe you have heard it/
(EWM-79)	x.çi=	'naya çurçi' 'ich werde wohl geben' 'Well, I will give/ /Then, I will have to give/'
(LBO-275)	x.çi=	'Pedroj aka qollqe luntatirikiçi' 'quizás Pedro hurtaría esta plata' 'perhaps Peter stole that silver/'
(MJHB-224)	x.çi=	'inas sarçi' 'maybe he went' (I don't know, have no data, and don't care) /quoted in English by IGR/
(MJHB-224)	x.çi=	'ninaçim jivaraskçi' 'I'll bet the fire is going out' 'quoted in English by IGR/'

The very complex statement x.çi has been illustrated by many examples taken from various grammar textbooks to demonstrate that the suffix çi has been used consistently over the centuries; neither its meaning nor its position in the sentence has changed. Also worth noting are the attempts made by these linguists to translate these sentences into their respective languages. Without a doubt, statements involving çi unequivocally show the difference between those languages which are based on bivalent logic, and Aymara, which is based on three-valued logic. Aymara deals with these statements-systematically, and there is no need to invent convoluted sentences to express the various degrees of conjecture.

When Aymara sentences contain the adverb "inasa" the Spanish adverbs of doubt, "perhaps" and "maybe" can be used in the translation: their meaning is close enough. However, in all other cases, these words do not give an accurate translation.

Statements using çi alone and in combination with other logical suffixes will be discussed below. There is no other way to accurately obtain the corresponding kimsakus. One cannot analyze each and every kind of conjectural Statement, because the translations themselves are arbitrary. After Tarifa, the term "será que.." / it may be that / will be used to translate "ina", and the conjunctions "ni" / neither /; "o" / or /, and "tampoco" / either / will be used to translate the suffixes "sa", "ça" and "lla." As will be explained below, the suffix "lla", sometimes translated by "pues" / perhaps / is very different from the word "pues" / for sure / used to translate the suffix "pi". The Aymara statements are first translated using idioms common in the variety of Spanish spoken in Bolivia. Then, formal expressions used in modal logic, adapted to Aymara, will be used to give a more clear and technical meaning to the translations.

x.çi =	'lurçi' = (0,1,0) 'habrá hecho nomás' /He has done it perhaps/ 'it is feasible that x and not -x' 'it is contingent that x'
x.çi =	'inaj lurçi' 'será que habrá hecho nomás' /He might perhaps have done it/ 'perhaps yes, perhaps not x'
x.sa.çi =	'inasa lurçi' (1,1,0) 'ni será que habrá hecho nomás' /Might it not be that he has done it/ 'perhaps he has done it'

	'it is plausible that x'
x.ça.çi =	'inaça lurçi' (0,0,0) 'o será que habrá hecho nomás' /Or perhaps he has done it/ 'it does not matter if he has done it' 'who knows if he has done it' 'it is aoristic that x'
x.lla.ka.çi.ti =	'janilla lurkçiti' (-1,1,1) 'acaso tampoco no será que habrá hecho' 'possible, too, ha has not done it at all/ 'It is doubtful that x (synonym of x.ça)
x.çi.lla =	'jupaçinilla lurirej' (0,-1,0) 'tampoco será que él tendrá que gustar de hacer' 'there is no doubt about doing it, perhaps he likes doing it' 'it is unfavorable that it is contingent that x' 'it is in-contingent that x'
x.lla.çi=	'janilla lurçi' (0,1,1) 'tampoco no será que habrá hecho' 'it is contingently unfavorable that x' (antonym of x.sa.çi)
x.ti.sa.çi =	'janiṭ inaṣ lurçi' (0,1,1) 'acaso, quizás no ha hecho' (synonym of x.la.çi) (antonym of x.sa.çi) 'it is contingent that it is adversative that is questionable that x'

4.5.2.-Determination of x.çi.pi = (-1,1,-1) (Total contingency)

- 'jutçipi'
- 'será pues que vendrá'
- 'it is possible that x and that not-x'
- 'it is certainly contingent that /he/ will come'

The convolutions in the Spanish language necessary to translate these statements of conjecture show how difficult this task is. In Spanish, the negation involves only one operator; therefore, modal statements of doubt tend to be either affirmative or negative. There is no room for symmetrical doubt. The syntax of Aymara is based on a three-valued logic; negation involves two independent operators (ka and ti), between which one can intercalate the suffix çi, the operator of the contingency modus(sic); this makes it possible to form completely symmetric statements of doubt which, consequently, are impossible to translate into any language based on a bivalent system of logic.

It would be very interesting to discover whether there are other languages existing today which use two independent suffixes to make negative statements.

It should be pointed out that in Aymara the notion of contingency involved in statements of the type x.çi very different from Aristotle's ("it is not necessary and not at all impossible that x.") The Aristotelian notion corresponds to statements of total contingency in Aymara of the type x.çi.pi.

The modal notions "it is contingent that x " and "it is in-contingent that x " differ in this respect: the first statement involves some doubt because it is uncertain whether the statement is true or false. However, the second statement does not involve doubt ($p_2 = -1$); the statement must be either true or false; however, this remains "to be seen" there are no clues in the statement, so $p_1 = p_3 = 0$. "It is in-contingent that x " and "there is no doubt that x " are not identical. For people who think according to a bivalent system of logic, the notion of in-contingency is absurd. For someone with a trivalent mind, this is just another logical modality which may be used to reach conclusions.

In a statement of the type $x.ci.lla$, there is only one certainty: the statement involves some doubt, but it is uncertain whether the statement is true or false. The reason for this is that the statement usually involves two aspects; this can be seen in our example, the amodal counterpart of which is "he will have to do"; there is no doubt that it will have to be done (by somebody), but it is uncertain whether he will be the one to do it. Its triad, therefore, is $(0,-1,0)$.

Both "it is contingent that x " and "it is certainly contingent that x " are clearly conjectural modalities, so in both cases $p_2 = 1$. Both are symmetrical, i.e., $p_1 = p_3$. They differ in one respect: in the case of $x.ci$ it is not known whether the statement is true or false; however, there is no indication whether it should be affirmative or negative, so $p_1 = p_3 = 0$. The statement $x.ci.pi$, however, implies that it is not necessary and not at all impossible that x ; in other words, neither truth nor falsity are expected; thus, $p_1 = p_3 = -1$, there is absolute doubt.

There is another statement which is symmetric, and, therefore, impossible to translate. This statement does not involve a doubt per se, but rather the modality "it is aoristic that x ." A statement such as $x.ca.ci$ indicates a total lack of interest for any truth-value the statement may have, either because it is impossible to determine or because said truth-value is irrelevant. Thus, the three values in the triad are doubtful; the symmetrical kimsaku $(0,0,0)$ is its negation as well as its antonym.

Note: According to Casares' dictionary, the word "aoristic" means "philosophical doubt", "uncertainty". The word comes from Greek and expresses a grammatical modality(sic) of indefiniteness. I can find no better term in Spanish for a modality in which even doubt itself is doubtful.

The other statements with the suffix, ci are not symmetrical, and, accordingly, can be translated into Spanish. This is particularly true of the statement $x.sa.ci$, the well-known "perhaps x ". There is a doubt, thus, $p_2 = 1$. What is in doubt is the certitude that not $-x$, so $p_3 = 0$. It is expected that x is true, so $p_1 = 1$. Thus, the triad is $(1,1,0)$. The statements $x.ti.sa.ci$ and $x.la.ci$ are the antonym of the statement $x.sa.ci$; The kimsaku of the antonym is obvious, because it can be obtained by symmetry $(0,1,1)$.

These forms of asymmetric doubt will be rendered in Spanish using the following formal expressions:

- $x.sa.ci$ = 'it is plausible that x '
- $x.ti.sa.ci$ = 'it is plausible that not $-x$ '

Here, I should point out that it was precisely after struggling to interpret accurately the modalities expressed by the suffix ci, that I decided to apply the methods of mathematical logic to the study of the logic of the Aymara language. Upon realizing that a statement of the type $x.ci$ was symmetrical, I decided to conduct serious research using mathematical logic to determine the behavior of the different logical suffixes of Aymara, based on the hypothesis that these suffixes generate trivalent statements.

Evidently, to anyone who studies the Qoya language, the suffix ci appears as something very peculiar, and it is precisely the symmetrical doubtful statements (sic) which reveal the non-Aristotelian character of the Aymara system of logic. The following paragraphs quoted (and in some cases translated) from the most significant grammar textbooks illustrate the reactions of several linguists who have analyzed the suffix ci:

(LBO-275) "Regarding the particle chic: this particle is included among the adverbs; in that section it is stated that chic has the meaning of the word "forsitan" ("perhaps" in Latin), and that it is used in sentences involving doubt, as explained therein; it has also been pointed out that chi is used to form conditional sentences in the indicative mood. Here it must be added that the Indians usually insert this particle when communicating information about something."

(LBO-239): "In this language, these adverbs are translated using "inaja" or simply "ja"; the particle "chi" is also added, but it is ornamental, ... ja is added to that which is doubted."

(LBO-239): "These two particles, chi and ; ja, added to the interrogative words mentioned above mean "I do not know", for example, "kitichija" = "I don't know who it is."

(LBO-240): "Finally, the particles ja and chi often serve a purely ornamental purpose when added to the abovementioned interrogative words; however, in those instances they are not interrogative, but "indefinite."

(LB2-174): "ina aro" = "wrong word which need not be taken notice of"; "inaja" = "perhaps, maybe"; "inaki" = "in vain, wrongly".

(LB1-379): "just in case" = "inajaki".

(DTR-159): "inacca, inasa = perhaps" (In the grammar section, there is nothing about chi).

(EWM-149) "CHI": dieser Partikel drueckt Ungewissheit und Zweifel aus und wird in dieser Bedeutung teils zwischen Stamm und Endung eingeschaltet, teils an die Verbalformen eingefuegt. Dass CHI zur Bildung eines zweiten Futurums benutzt wird, ist bereits im Kapitel der Konjugation eingefuehrt worden." (çi: This particle expresses uncertainty and doubt; it has this meaning when it is inserted between the root and the ending; or when it is added to the verbal form. The fact that çi is used to form a second future has already been mentioned in the chapter on conjugation).

(JEE-84) "In Aymara the adverb of doubt is "inaj" = "perhaps, maybe." However, in sentences expressing doubt, the verb has its own conjugation, generally involving the particle chi."

(JEE-314) "ina = in vain"; 'inach = perhaps, maybe; 'inas = perhaps, maybe."

(ETA-275) "The verb tenses in which CHI appears as a verb ending are equivalent to the Future Imperfect and the periphrastic tenses of the Indicative mood or to the present of the Subjunctive mood."

(MJHB-223) "Non-involver: this tense has also been called the guesser, the conjectural, the suppositional, and the lamentor. The use of this tense indicates lack of involvement in the matter, by the speaker primarily, but may invoke subject and/or complement. The nature of the non-involvement is determined by sentence suffixes and/or particles elsewhere in the sentence. Non-involvement may be because there is no information or it may be emotional, or both." /quoted in English by IGR/ [\(11\)](#)

(MJHB-223) "(one common use is) when no data is available, so that the statement constitutes a best guess. However, the implication is usually that the speaker doesn't really care, one way or the other". /quoted in English by IGR/

(IIM2-54)"chi: strong verbal suffix which expresses doubt. It corresponds to the dubitative mood. This suffix cannot be translated when used alone. In the destruction (sic), it is accompanied by "inasa" (perhaps).

4.5.3.-Determination of x.ça = (-1,1,1) (Doubt)

The statement x.ça is both conjectural and interrogative meaning; it is also the antonym of statements of possibility. It might more accurately be classified among the modalities of questioning. In compound statements the suffix ça also functions as a connective operator of alternative. Despite its various grammatical functions the suffix ça may have only one kimsaku, as will be determined below:

Examples:

(ETA-271) x.ça =	'jumaça lurta' 'o eres tú el que hizo' /or is it you who did it/ 'it is doubtful that it is you who did it'
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(ETA-271) x.ça =	'lurtaça' 'o (tú) has hecho?' /or have (you) done?/
(ETA-272) x.ça =	'luranaça?' 'o hay que hacer?' /or does one have to do it?/
(ETA-272) x.ça =	'yatiritakiça?' 'o es para el que sabe?' /or is it for the one who knows?/
(ETA-273) x.ça =	'aljiriça uka çarkinaka çurtama. janiça ukjamaki?' 'o es el vendedor el que te dio esos tajos (de carne seca), o no es así?' /or is it the salesman who gave you these chunks (of dried meat) or is it not he?/

These examples show that statements in which the suffix ça appears raise an interrogation (sic) (because they can be answered yes or no); however, at the same time they are also questions (because an explanation is required). Also, these statements are all logical equivalents of "it is possible that not p", i.e., they are the antonyms of statements of possibility (this should not be confused with impossibility (which is the antonym of certainty). Yet, these statements containing ça are also the opposite of statements of certainty, because they amount to saying "not necessarily x"; or also, "it is uncertain that x." The x.ça statement involves doubt that x may not happen; so, $p1 = -1$, $p2 = 1$ and $p3 = 1$. Thus, the triad for x.ça is the opposite of x.pi, which indicates precisely the uncertainty conveyed by the statement.

Comments: (ETA-271) "CHA, is a disjunctive verbal ending, used to conjugate verbs, much the same as WA". "Such modes of expression reflect doubt or negation." The word CHHA (ça) and the suffix ça also exist, but they are in no way related to CHA."

The role played by this suffix as a connective will be analyzed in our discussion of compound statements. Bertonio's greatest difficulty was in grasping the logical meaning of some suffixes, such as "ça", which differ radically from European languages in the way they generate connective statements. However, in Bertonio's grammar (p. 244) under the heading "disjunctive conjunctions" there are some examples of the use of "ça" and the connective "mişka". These particles are evidently used to construct statements which today would be called "alternative." For example: Bertonio records these sentences: "kitiça usu?" (Is anybody sick, by chance?); "Pedroj jutiti janiça?" (Has Peter come or not?)

MODALITIES OF CONJECTURE IN AYMARA	
Formal Statement	Antonym
$x.sa.çi = (1,1,0)$ 'it is plausible that x'	$x.la.çi = (0,1,1)$ 'it is plausible that not -x'
$x.ça.çi.ti = (1,1,0)$ 'it is hesitable that x' (12)	$x.la.çi = (0,1,1)$ 'it is hesitable that not -x'
$x.sa.ça = (1,1,-1)$ 'it is doubtful that not -x'	$x.ça = (-1,1,1)$ 'it is doubtful that x'
$x.çi = (0,1,0)$ 'it is contingent that x'	

$x.\dot{\varsigma}i.pi = (-1,1,-1)$ 'it is certainly contingent that x'
$x.\dot{\varsigma}i.lla = (0,-1,0)$ (opposite of $x.\dot{\varsigma}i$) 'it is in-contingent that x'
$x.\dot{\varsigma}a.\dot{\varsigma}i = (0,0,0)$ 'it is aoristic that x'

The conjecture $x.sa.\dot{\varsigma}i$ is the logical synonym of the feasibility $x.ska$; the same applies to their respective opposites.

4.6.-Double connective statements: **päkimsakus**.

As used in this book, a double connective statement is a logical proposition consisting of two simple statements linked together by a connective operator.

For example, the proposition:

- $p =$ 'you come and he leaves'

is made up of these two simple state

- $x =$ 'you come'
- $y =$ 'he leaves'

linked by a connective operator "and"; this can be written:

$P = x/y$ ('/' represents the conjunction 'and') In Spanish, as in most European languages, double connective statements have the following structure:

$p(x,y) =$ statement 1 + connective + statement 2. Thus, the logical meaning of the statement depends solely on the connective, rather than on the modality of the individual statements. Therefore, in bivalent propositional logic, statements "x" and "y" are considered amodal. In some instances, the connective involves two words, for example, the implication "if x then y": however, these words do not affect the modality of the simple statements involved.

In Aymara, connective statements are expressed in a radically different way; this explains why these kinds of statements have not yet been fully understood and explained by researchers of Aymara grammar. The truth-tables for the connective statements can be analyzed; these statements are also subject to a definition of the function $p(x,y)$. Thus, mathematics can help linguistics towards a better understanding of Aymara syntax.

Connective statements in Aymara differ from those to which we are accustomed(sic) in that in the Qoya language the simple statements which make up the proposition must be modal, i.e, include a modal suffix. The connective is also expressed by modal suffixes. This feature is a complication for anyone trying to translate the modalities and the connective. However, for Aymara-thinking people, it is the simplest way of handling a very large number of connectives; theoretically, the number may reach $3 \times 9 = 19\ 683$ possible combinations. In Aymara, double connective statements have the following form:

$p(x,y) =$ statement 1.M1 + connective A + statement 2.M2 where M1 and M2 are modal suffixes, and A represents the linking suffix.

Modal suffixes M1 and M2 are often identical. The connective is generally the word "uka", the pronoun "it", also translated as "that". Thus, far different A suffixes, there are connective expressions such as "ukasti", "ukaska", "ukampisa", etc. Bertonio's dictionary also mentions the connectives "tu" in expressions such as "tullanska" and "mi" as in "mička" these connectives are apparently no longer used. This singular method of using a connective with its

linking modalities has, of course, no similarity with Indo-European languages, giving rise to a strange algebraic etymology of connective words.

As explained in section 4, modern grammars only study the modal function (potential-gerundive) of the compound suffix "ska" (a combination of "su" and "/ka".) However, Bertonio recorded many examples of the connective function of this suffix, not only in the linker "ukaska", but also as a non-verbal suffix. For example: (LB2-148) "masürska" (yesterday but.)

For this reason, the translation of Aymara functors has always puzzled linguists, who have arrived at the simplistic opinion that Aymara has no precise way of formulating logical connective propositions. For example, in his grammar, M. Hardman B. (MJHB) states that "there are no connective functors in Aymara!"

This is the key to the serious problems of misunderstanding between Aymara- and Spanish-speaking people in Bolivia and Peru. One should probably add to this lack of communication the fact that many of the logical double propositions are not used consistently by Aymaras themselves, because of their low level of education.

Before discussing different kinds of connective statements, it must be pointed out that linguists have not been able to explain precisely the logical meaning of connective words; yet, some of them have grasped the syntactical role of "uka" and its various modal suffixes. Ludovico Bertonio was aware of it; for example, when describing the statement of implication with suffix "çi" he stated:

(LBO-431) "If, when, is (sic) conditional; Chi, for example, "If you are rich, why don't you give alms?" = Ccapacaçitha, cuna supa hani huakhchanaccho ccuyatha? However, the particle chi is used only in the present and past tenses of the Indicative mood, almost never in the future, or in tenses of other moods. These sentences are conditional because the particle Ucaca, vel Ucasca, or Ucapilla, is used before the second sentence element, for example: "If you die, or died in sin, you will, or would, go to hell" would be rendered = "Hochani hihuahata, hihuasma, vel hiwuiricta, o hiuassina: Ucapilla ucaca vel ucasca infiernoru mirictawa"; the same is true when there are two assumptions, as can be easily seen."

It is also evident that Bertonio needed logic for his missionary work, which forced him to study the form expressing implication. Despite his lack of precision, Bertonio's work is valuable because he recognized that connective statements require modalities and the connective "uka" is followed by modal linking suffixes.

To this day, probably the most comprehensive study of Aymara syntax ever conducted is the research conducted by the scientific team from the University of Florida. Although English equivalents are not provided, the syntactic function of "uka" and its modal forms are clearly explained in the grammar authored by Hardman-Vazquez and Yapita. The following paragraph serves to illustrate this:

(VY-453): "Uka is about the roost versatile and useful root in the language. Its uses as a demonstrative and a linker have already been discussed, as well as its unique position as head of a noun phrase (jupan uk, 'at her house'). Uka may also act as a resumator of any kind of a grammatical structure, thus reducing this structure to that of a simple noun, and in this way its subordination. Some other features are characteristic of the structure to be subordinated, but subordination is made effective through the resumating action of uka. Indeed, it may act alone, suffixless, as total resumator." / quoted in English by IGR/

Evidently, as Hardman points out, connective words serve as both linkers and resumators. When used as a linker, the connective is placed between the two simple statements. When it acts as a resumator, the connective is added at the end of the two simple statements. Thus, in Aymara propositional logic, a double connective statement may be formally expressed as follows:

- $p(x,y) = x.M1 + (xy).A + y.M2$
- $p(x,y) = x.M1 + y.M2 = (xy).A$

In these expressions, the symbols "x" and "y" represent simple statements, followed by their respective modal stands for the suffixes "M1" and "M2". The term "(xy)" stands for the connective between the two simple statements, which in Aymara is almost always "uka". The linkage modality is conveyed by suffix "A", thus "(xy).A" represents the typical connective word for the logic of the statement, but in relation to the modal suffixes M1 and M2. The same connective may have different logical functions, depending on which simple modal statement it is used with.

The parentheses in the term "(xy).A" indicate that the suffix applies to the "product" of the simple statements, i.e, to both of them. This meaning will be described algebraically below. Suffix "A" always acts upon product xy, therefore, the parentheses can be omitted, and the connective term written simply "xy.A". Sometimes, the connective term contains the adverb of negation "jani" in addition to the linking suffix "A", for example, "jan ukaçti" (but, except). As negation involves a change of sign in our propositional variables, such an example will be written "-xy.çti", or, in general, "-xy.A". This convention can also be algebraically established. As has already been indicated, the logical definition of any simple logical proposition is arrived at by determining its kimsakus since for the three values of x there are three values of $p = x.M$. However, for a double connective logical proposition, the statement now has nine possible values:

- $p = x.M1 + y.M2 + xy.A,$

which correspond to the nine combinations of truth-values for "x" and "y". Thus, the logic of a double statement is not specified by a triad, but by a nine-element matrix. It could be referred to as a second-order triad having $3^2=9$ elements. A triple statement, made up of three simple statements, has a third-order triad with $3^3=9$ elements, and so on.

The second-order triad will be displayed as a nine-element row rather than in rows and columns, as matrixes are usually represented. This display will prove very useful for the analysis of truth-tables or matrixes with respect to inferential problems. This kind of second-order triad will be called "päkimsaku."

As has already been said, whereas in bivalent logic there are only $2^4 = 16$ possible combinations (second-order diads), in trivalent logic there are $3^4 = 19683$ second-order triads. Thus, it is not practical to give a special name or symbol to each double statement in Aymara, as is usual in bivalent logic. In some instances, one can make logical "analogies", to try to reach an approximate equivalent translation; however, the reader should bear in mind that there is no equivalence between bivalent and trivalent connectives.

The examples used in this book to determine first-order triads, or kimsakus, for modal statements were taken from Aymara grammars printed over the past four centuries. This procedure ensures that the triad assigned to any simple suffix is absolutely correct and originates from the Aymara language itself. They can be, verified algebraically.

It would have been ideal to follow the same procedure of logical analysis to determine second-order triads which correspond to double connective statements. Unfortunately, the grammars give very few examples of connective logical propositions, and the translations of these few examples are not always consistent, and, in some cases, are even contradictory. Therefore, I suggest rather that connective statements be generated by following the logical syntax of Aymara which can be deduced from what has been studied and established up to this point. The logical meaning of these statements can later be verified by checking with Aymara-speaking people. Finally, the trial by fire will be the algebraic method, which obviously must apply also to connective statements, as will demonstrated below.

SOME BICONNECTIVE FUNCTORS of AYMARA: $p(x,y)$									
x =	1	0	-1	1	0	-1	1	0	-1
y =	1	1	1	0	0	0	-1	-1	-1
Conjunctions (x/\y):	.								
x.çti+y.çti+xy.ska	=	1	0	-1	0	-1	-1	-1	-1
x.ska + y.ska + xy.ça	=	1	0	-1	0	0	-1	-1	-1
x.mpi + y.mpi + xy.lla.pi	=	1	-1	-1	-1	0	-1	-1	-1
Adjunctions (neither x not y):	.								

x.sa+ y.sa+xy.sa.pi	=	-1	-1	-1	-1	-1	0	-1	0	1
x.lla+y.lla+xy.ki	=	-1	-1	-1	-1	0	0	-1	0	1
x.wisa+y.wisa+xy.lla.pi	=	-1	-1	-1	-1	0	-1	-1	-1	1
Disjunctions (inclusive or alternative x or y) : .										
x.ça+y.ça+xy.lla.ska	=	1	1	1	1	0	0	1	0	-1
x.sa.lla+y.sa.lla+xy.sti	=	1	1	1	1	1	0	1	0	-1
Implications (if x then y): .										
x.ka+ y.su+xy.lla.pi	=	1	-1	0	1	-1	0	-1	0	1
x.ka+y.su+ xy.ça	=	1	0	1	1	1	-1	-1	-1	1
x.ska.çi+y.ki+ xy.salla	=	1	1	1	0	0	1	-1	0	1
x.lla+y.salla+xy.ça	=	1	1	1	0	1	1	-1	0	1
x.wa+y.çti+xy.ja	=	1	0	1	0	-1	0	-1	-1	1

Examples:

- mantaçti umtaçti ukaska
y comiste y bebiste 'en ese caso'
/and you ate and you drank in that case/
- warmipami jilapampi tullanpi jutiwa
tanto con su mujer como con su hermano 'y todo' ha venido
/both with his wife and his brother "and all" has come/

4.7.-The algebraic method

Following the method of logical analysis outlined in the preceding section, the kimsakus for the functors generated by the various logical suffixes of Aymara were obtained from the logical meaning of the statements to be analyzed.

However, as the reader may already have noticed, this logical meaning is, in the final analysis, a matter of interpretation. In some instances, for example, in negation, it is patently clear that the statement has been assigned the right kimsaku. In other cases, the assigned kimsaku is less obvious, and even arguable. This is particularly so when the Spanish translations are used for the logical analysis of Aymara statements, as the interpretation may lead to serious objections to the methods used.

In this section, the reader will find a rigorous and convincing method for demonstrating that the syntax of Aymara is based on a trivalent system of logic. This is the key finding of the research on Aymara logic presented in this work. The use of mathematical language is unavoidable for this reason; however, given the nature of this monograph, mathematics will be used sparingly and only when absolutely necessary.

Although this may seem surprising, it can be stated without doubt that the logical syntax of Aymara has an algebraic, trinary, ring structure. The trinary digits 1, 0, -1, will be used to define this algebraic ring which shall be called "Aymara siwi" (Aymara ring), in honor of our forefathers, those Qoya scientists who designed the syntax of this language. (sic)

Aymara siwi can be defined by the following axioms:

A1: "Aymara siwi" covers the set of trinary digits: $\{1,0,-1\}$. These digits will be called "**trits**", to draw an analogy between them and the "**bits**" of Boole's binary algebra.

Trit 1 is equivalent to bit 1; both represent the truth-value "true". Trit 0 represents the third truth value (perhaps true and perhaps false.) Obviously, trit 0 has no binary equivalent. Trit -1 is the equivalent of bit 0; both represent the truth-value "false."

A2: "Aymara siwi" is structured by the operation which we shall call **product** of x times y , or simply $x * y$, established according to the following table:

$x=$	1	0	-1	1	0	-1	1	0	-1
$y=$	1	1	1	0	0	0	-1	-1	-1
$x*y=$	1	0	-1	0	0	0	-1	0	1

A3: "Aymara siwi" is also structured by an operation which we shall call **addition** of x plus y , or simply, $x \pm y$, established by the following table:

$x=$	1	0	-1	1	0	-1	1	0	-1
$y=$	1	1	1	0	0	0	-1	-1	-1
$x+y=$	-1	1	0	1	0	-1	0	-1	1

These three axioms show that all variables in "Aymara siwi" have the following properties:

- P1: There is always a trinary number R such that:
 $y = x + R$; the number R will be called $y - x$, (y minus x)
- P2: $y - x = y + (-x)$ where $(-x)$ means $(-1)*x$
- P3: $x + x = -x$
- P4: $x + x + x = 0$
- P5: $x * x * x = x$
- P6: $x * y = y * x$ (product is commutative)
- P7: $x \pm y = y \pm x$ (the sum is commutative)
- P8: $x * (y * z) = (x * y) * z$ (product is associative)
- P10: $x + (y+z) = (x + y) + z$ (the sum is associative)
- P11: $x * (y+z) = x * y + x * z$ (distributivity)

It is now evident that the "Aymara siwi" has the properties of a ring. As readers well versed in mathematical logic will surely have noticed, the "Aymara siwi" differs from Boolean algebra in this respect: the algebraic operations of multiplication and addition are not identical to the logical operations of conjunction ("and"), and adjunction (alternative "or"). However, it can be mathematically demonstrated that all functions of Aymara trivalent logic can be expressed using the operators "*" and "+" of the "Aymara siwi."

For example, the following are the polynomial expressions for some of the modal functors mentioned in the preceding sections:

$$x.k_a = -1 - x$$

$$x.ti = 1 + x$$

$$x.ka.ti = -x$$

$$x.pi = -1 + x + x * x$$

$$x.su = 1 + x - x * x$$

Using the tables which appear in axioms A1 and A2, the reader will be convinced that the kimsakus which were obtained for the modal statements following the methods of logical analysis are in fact generated by these polynomials. In other words, two different and independent methods lead to identical results, which, accordingly, confirm each other.

The most surprising finding is that the logical suffixes of Aymara are algebraic operators. This can be easily proven as follows:

- let $p(x)$ be the function $x.ka$
- and let $q(x)$ be the function $x.ti$
- evidently, the function $x.ka.ti$ becomes $q(p(x)) = -x$

This same test can be used for more than a hundred logical compound suffixes currently in use in present-day Aymara; and for suffixes recorded in the grammars written four centuries ago. In all cases, without exception, it can be demonstrated that for any compound suffix in a statement determined by suffixes S1 and S2:

it is always true that:

$$\text{if } p(x) = x.S1 \text{ and } q(x) = x.S2$$

$$\text{then } q(p(x)) = x.S1.S2$$

As an exercise, the reader is invited to verify that:

- $x.ska = (x.su).ka.$

It is further suggested that the reader find the polynomial for $x.sa$; then use the polynomial for $x.ti$ given above, to prove that:

- $x.sti = (x.sa).ti.$

Likewise, for the connective functions there are polynomials with several variables; they can be used to calculate the values of any truth-table, for example:

- $x \ y = x.\dot{c}a + x.\dot{c}a = xy.lla.ska = -x-y+xy-xx-yy+xyxy$
- $x \ y = x.ska + x.ska + xy.\dot{c}a = -x-y-xy+xx+yy-xyxy$
- where $xy = x*y$

These results have been presented rather sketchily; however, it will have served to give an idea of the tremendous power of "Aymara siwi": Any modal or connective statement can be represented by its corresponding polynomial, which is formed with just two operators: '*' and '+'.

Now, in "Aymara siwi" any solution to an inferential problem is equal to the solution of a system of (linear) equations. In fact, truth-tables are not necessary, since they are only a representation of the results which can be calculated either manually or with a computer using axioms A1, A2, and A3.

In Boolean algebra, a propositional variable x cannot be (algebraically) related to its negative Nx , which, in "Aymara siwi" is simply $-x$. Because of this, "Aymara siwi" is much more efficient than Boolean algebra, even for the solution of bivalent inferential problems, or the logic of binary circuits.

Based on these conclusions, I believe we are entitled to speak of Aymara logic as an original theory, which is as complete and consistent as Aristotelian logic. I also believe it is safe to say that Aymara logic is more ancient than Greek logic, as appears to be indicated by the results of archeological excavations at the site of the "taypi qala" ruins, also called Thiawanaku, which was the cradle of Qoya culture.

4.8.-Summary of simple modal suffixes of the Aymara language

$::$ = 'it is a synonym of'

$-:$ = 'it is an antonym of'

Synonyms		
$x.pi = (1, -1, -1)$	$::$	$-x.ça$
$x.ça = (-1, 1, 1)$	$::$	$-x.pi$
$x."su = (1, 1, -1)$	$::$	$(-x).ça$
$x.ki = (1, 0, 0)$	$::$	$-x.lla$
$x.lla = (-1, 0, 0)$	$::$	$-x.ki$
$x.sa = (0, 0, 1)$	$::$	$(-x).ki$
$x.ka = (1, -1, 0)$	$::$	$-x.ti$
$x.ti = (-1, 1, 0)$	$::$	$-x.ka$

$x.çi = (0, 1, 0)$

'it is contingent that x '

Antonyms		
$x.pi$	$-:$	$x.sa.pi$
$x.su$	$-:$	$x.ça$
$x.ki$	$-:$	$x.sa$
$x.sa.lla$	$-:$	$x.lla$
$x.ska$	$-:$	$x.ti.ska$
$x.ti.ka$	$-:$	$x.ti$

(1) Translator's note: "siempre" means "always"; it is used here in a very peculiar way, which would be difficult to understand in other Spanish-speaking countries

(2) Translator's Note: According to standard Spanish grammars (including the Spanish Academy's) there are five moods: the Indicative, the Subjunctive, the Imperative, the Potential /Conditional/, and the Infinitive.

(3) Translator's Note: IGR uses the word "Abdiccion", which is not recorded in standard Spanish dictionaries. He may have in m 3 the Spanish word "abduccion" (a syllogism in which the Major Premise is evident and the Minor Premise is probable). Webster's Collegiate Dictionary does not give this meaning for the English word "abduction".

It must be pointed out that in Charles Sanders Pierce's philosophy, "abduction" is that kind of reasoning that derives an explanatory hypothesis from a given set of facts.

(4) Translator's Note: IGA says the above expressions are auxiliary verbs in Spanish. They are not. However, their English counterparts are. The author might have been thinking of the English forms.

(5) IGR says "interrogative mood" (T's note)

(6) Translator's Note: "acaso" (no accent) normally means "by any chance in these sentences it is used as an adverb of doubt meaning "perhaps, maybe". "siempre" means "always"; it is used here mean "in any case " (app. value)

(7) Translator's Note: IGR uses the word "adversidad" /adversity, misfortune/

(8) Translator's Note: The word "ni" /neither/ is used in this context to indicate a resounding negative.

(9) Translator's Note: IGR uses "adverse"

(10) Translator's Note: IGR uses "adverse"

(11) Translator's Note: This quote is translated by IGR in the Spanish original. The English word "tense" is translated once by "tiempo" /tense/, but later on the author uses "modo" /mood/ to render it in Spanish. Thus , the reader must be aware of the possibility of any confusion between these two terms in this work.

(12)) Translator's Note: IGR uses the word *hesitable* in Spanish, which is not recorded in standard dictionaries of Spanish. It is suspected this term is IGR's personal translation of an English term involving "hesitate" or "hesitation."

CHAPTER FIVE

CAUSES OF MISUNDERSTANDING IN SOCIAL COMMUNICATION

When two people who are having a conversation do not understand each other, the usual complaint is that they "are not speaking the same language." This reference to "a common language" generally means that if people are to understand each other, the same vocabulary is essential. However, this reference to a "common language" has another connotation, which is often overlooked: mutual comprehension also requires using the same system of logic, since, despite a widespread misconception, there is more than one.

In any language, the meaning of the words is determined by semantics; its logic, however, is embedded in its syntax. Therefore, "the same language" involves using identical semantics and identical syntax.

Many languages are spoken throughout the Western world. However, understanding among people is possible because all of these languages are based on the same semantic and syntactic categories; one language may differ from another in terms of : linguistic structure; however, all of them are isomorphic. This semantic and syntactic isomorphism makes possible translation, i.e., to reproduce in a given language the image of what has been said in a different one. Thus, the goal of "a common language" is achieved.

These remarks also apply to the relationship between computers and human beings. Let 's consider, for example, a computer program involving the following instructions: read the client's file; identify those who have not paid; send a type-A notice if payment is less than a month overdue; in other cases, send a type-B notice; however, if the client belongs to category 1, do not send any collection notice." These instructions can be written in different computer languages, provided their syntax can handle the logical schema involved in the instructions.

For the computer to execute this program, the circuits in the computer's central memory must be designed to handle the logical functions involved in the syntax of that particular programming language. Without these electronic circuits, the computer would not be able to handle such a program, and so its intelligence module would have to be expanded, or simply replaced.

However, if the logical capacity of the computer is underutilized because the syntax used by the programmer is inadequate, it would be advisable to replace that engineer with another who knows a more advanced language, which can give instructions adequate to the intelligence level of the equipment.

There is a centuries-old misunderstanding between the different social groups who live in the territories where the Qoya culture flourished, especially in regions of present-day Peru and Bolivia. This misunderstanding predates the Spanish conquest, and still exists today because people do not speak the same language nor use the same system of logic.

If this really is the cause of the misunderstanding, one may well ask whose "logical circuits" must be reprogrammed so that all members of our society can fully understand each other.

My research on Aymara logic would appear to suggest some guidelines which could contribute to solving this centuries-old misunderstanding within our society, in which two essentially different systems of logic function at loggerheads.

Applying methods of mathematical logic, I have attempt to determine whether Spanish and Aymara-speaking people make inferences in different ways, and, if so, to identify the differences, the areas of misunderstanding, and the maximum logical understanding that can be achieved.

The idea that there is something special about Aymara which sets it apart from other languages is not new. Both the early scholars and modern linguists who have studied the Qoya language have been fascinated by its highly logical structure. Although they have not, of course, used the powerful methods of mathematics to test their ideas, they have provided very interesting and revealing analyses of key aspects essential to understand the syntax of this language.

These linguistic works are invaluable material which can serve as a starting point for multidisciplinary research, Computer science may contribute not only to an understanding of the language, but also to revitalizing this millenary culture and adapting it to today's modern world.

To achieve this ambitious goal, Aymara-speaking people must have access to world literature. This requires findin. a solution to all the technical problems involved in translating into Aymara. This brings us to the key issues: the problems of misunderstanding, and the psychological effects subsequent to the communication.

5.1.-Channels and levels of communication

In a first attempt to conduct a systematic study of the problems hindering social communication between Aymara-speaking people and people who speak Spanish. (or for that matter, any Indo-European language) the following categories will be used to analyze the different instances of misunderstanding:

- a) Level: determined by the language and system of logic of the sender, the translator, and the receiver;
- b) Channel: determined by communication factors related to the environment, semantics, logic, ideology, and psychology, which influence communication as a whole. [\(1\)](#)

The following symbols are used as a key for the indexed file in which the different cases are stored:

- A = Aymara (language)
- C = Spanish /Castilian/ language
- P = Popular Spanish (spoken in the Altiplano)
- T = Trivalent logic
- B = Bivalent logic
- E = Sender (the originator of the message)
- R = Receiver (the person who receives the message)
- I = Interpreter (who interprets and translates the message)
- ME = Message sent
- MR = Message received
- IM = Message interpretation
- TM = Message translation
- M = Medium
- S = Semantics
- L = Logic
- I = Ideology
- P = Psychology

Example:

/EAT/IAPT/RCB/5 (L, P)

In this example of misunderstanding, a message sent by an Aymara-speaking person, who thinks according to a trivalent system of logic, was translated into colloquial Spanish by another Aymara-speaking person who also thinks according to a, trivalent system of logic, for someone who speaks correct Spanish and thinks according to a bivalent sytem of logic; this is an example of case 5 within that category, and involves logical and psychological problems.

5.2.-Some examples of misunderstanding

Some typical cases of misunderstanding related to the logical channels in particular are briefly discussed below. Collection, analysis, and classification of cases are on-going activities, but proceed very slowly because of a lack of institutional support.

5.2.1.-/EAT/IACB/RCB/10 (L, S, P,) I)

ME: 'kunalaykus ukjamaw luraraptapa?'

For what (logical) reason is it so (that way) that you have done it?/

MI: "Why have you so done it to him?"

(no distinction regarding the kind of "why?")

MT: "Why have you done it to him?"

(He does not feel "so", "this way" is necessary)

MR: "Why (for what reason) have you done it to him?"

(giving a causal interpretation to "why?")

Faced with a question so distorted by the interpreter, the receiver will give an answer which implies cause or motive, for instance:

"Because I wanted to help him."

However, the sender was expecting an explanation about the manner of doing it, for example "Because a use in this way we save time, since ..."

In this case, the misunderstanding is due to the fact that Spanish does not have different words to translate the various "why's?" of Aymara:

'kunalaykus?'

(a reason or logical cause is asked.for)

'kunasupas?'

(asking about the cause in the sense of a cause and effect relationship)

'kuna çuymampirakis?'

(the motive or psychological cause is demanded)

Although the difficulty has an impact on the logical and psychological channels, its origin lies in the semantic channel because of the vague meaning of the Spanish "por qué? /why?/; however, if we search even deeper, we may find that the true cause of this case of misunderstanding lies in the ideological channel.

Bertonio wrote his grammar between 1585 and 1602. Apparently, at that time he was not yet pressured by church authorities, as he may have been when he published his dictionary ten years later. The roles of the suffixes "layku" and "supa" are clearly explained in his grammar (p. 210). The word "layku" meaning "reason" can still be found in his dictionary, although the word "supa" is already tainted by ideological connotations (the theology of those times), to such an extent that "supayo" is translated as "devil" (LB1- 328).

The explanation is more or less obvious: the word "supa" when used as a nucleus, not as a suffix, means "cause"; therefore, the verb "supaña" should mean "to cause", and the verb "supayaña" would mean "to make to cause". Thus, "supayo" would mean something like "the one who causes", or "cause of causes". Every word fundamental to Qoya ideology was combatted by the Church, which managed to associate them with demoniacal concepts. Another typical example is the word "yatiri" ("wise man"), derived from the verb "yatiña" (to know), which is sometimes, even today, translated as "sorcerer".

There is another kind of difficulty related to the Spanish word "por qué?", and especially the English word "why": The answer is introduced by "porque" /because/. This is not the case in Aymara: the same suffix "layku" is added at the end of the answer; for example "ukalaykü" (because of that). However, the missionaries, most of whom are English-speaking, have coined the term "kunalaykutej" to translate the English word "because", trying to impose English syntax on Aymara. This, of course, causes serious misunderstandings in the psychological, logical, and semantic channels, but which originate in the ideological channel.

5.2.2.-/EPT/RCB/07 (L, P)

ME: 'mañana he de estar viniendo nomás' /I will be coming tomorrow probably/ (the speaker indicates his desire to come, but does not commit himself) 'çaruru jutaskatki' (thinking in Aymara)

$x.ska.ki = (1,1,1)$

Trivalent tautology, always true, never a lie.

MR: "mañana vendré" /I will come tomorrow/ (neglecting the modalities expressed in Aymara)

Result: A poor logical translation causes psychological conflict; if the sender does not come tomorrow, the receiver will consider him a liar, although he has told no lie because what he has said is a tautology, and he is always right. This kind of sentence using the gerund, and the word "nomás" /probably/ at the end is very frequent in the variety of Spanish spoken in La Paz, especially in the case of "promises" which are never kept. Speaking of tautologies, it should be brought to the attention of those readers well versed in logic that the statement "x or not x" is a tautology in bivalent logic, but not in a trivalent system because its kimsaku is:

$x \vee N(x) = (1,0,1)$ (quasi-tautology)

instead of : $(1,1,1)$ (tautology)

as can be seen from Lukasiewicz's truth-tables.

In trivalent Aymara logic, besides the normal alternative " $\vee$ ", there is the stochastic alternative " $\vee$ "; it is evident that " $x \vee N(x)$ " is a tautology, as can easily be shown with the pä-kimsaku for the statement:

$x \vee y = x.sal.la + y.salla + xy.sti = (1,0,1,1,0,1,0,-1)$

where $y = -x$. In column 5, where $x = y = 0$, the value is 1, and not 0 as in the case of normal alternative.

5.2.3.-/EAC/RAT/5 (L, P)

ME: $x.ti$ = 'wawaruj manqaytati?', (the suffix ti has been chosen by mistake, following the recommendations in some grammars)

"did you feed the wawa?" (this is what he wanted to ask)

MR: "By any chance have you fed the wawa?" (correctly interpreting the meaning of ti)

Result: The modal suffix ti is misused and the interrogative statement is formulated in the logical channel in the negative form. The question should have been "wawaruj manqaytasti?" ('and have you made the wawa eat then?')

In the psychological channel the receiver is offended by the sender's insinuation of doubt concerning his having fed the wawa, when in fact the sender merely expected a confirmation that she had in fact been fed.

It should be pointed out that: $x.ti = (-1,1,0)$

whereas $x.sti = (1,1,-1)$.

The question could also have been posed using the antonym form of $x.ti$:

$x.ça.ti$ = 'janiça wawaruj manqaytati ?' (or have you not fed the wawa by any chance?), the kimsaku of which is $(0,1,-1)$

5.2.4.-/EAB/RAT/1 (M, I, L)

ME: The sender, because of ideological reasons in the channel of the means of communication, tries to use the orthographic rules of Spanish to transcribe Aymara; thus, the suffix "ka" is sometimes written 'ca', and sometimes 'qui'.

MR: The phonetic inconsistencies of Spanish are foreign to Aymara, a consistently logical language; thus, the receiver interprets 'ca' and 'qui' as two different suffixes, and possibly interprets "qui" as "ki", which may lead to a great deal of misunderstanding.

For example:

x.ka.ti = 'jumaj janiw jutktati.' (you have not come)

'jumajj janiw jutctati.' (Hispanicized orthography)

x.ka.ti = 'jupaj janiw jutkiti (He (or she) has not come)

'jupajj janiw jutkiti.' (Hispanicized orthography)

Explanation: The present perfect tense requires the suffix "/" which causes the elision of the "a" in suffix "ka". The suffix "ta" is the equivalent of the pronoun "you"/sing./ but "i" is the equivalent of the pronoun "he". In Spanish "ci" is not pronounced like "ki"; therefore, the same suffix "ca" must be written "qui". This inconsistency is not a problem for Spanish-thinking people, who do not have to be constantly identifying suffix strings when reading, as is the case for Aymara. However, this is a serious obstacle to both Aymara-thinking people and computers used for translation into Aymara; it is also unnecessary, since there is no reason to impose Spanish orthographic rules on the Aymara language.

5.2.5.-/EAB/RAT/2 (L, P)

ME: 'qaruruj jutam!' (misuse of the imperative, due to lack of education)
'tomorrow (to the party) you must (certainly) come.'
(.what speaker intended to say)

MR: 'Come tomorrow!' (imperative form of command)

Results: The incorrect utilization of modal suffixes in the channel generates feelings of offense in the psychological channel, because in Aymara the imperative is used only in rare circumstances, and is only acceptable when used by a person who has legitimate authority to exert command, for instance the mother of a minor.

The correct form would have been: 'qaruroj jamapini jutata!' (tomorrow you always must come for sure!)

Another negative question which must be used carefully is: x.ti.sti = (-1,1,1).

for example:

'luraraptatisti?' (and by any chance have you done it for me yet?)

This implies serious doubt about your having done it for me. It should be pointed out that this statement is the opposite of a statement conveying possibility, i.e., in formal logical language it means: "it is possible that you have not done it for me.

5.2.6.-/EAB/RAT/3 (L, P)

Below is an interpretation in popular Spanish of two frequent antonymous expressions that must not be confused:

x.sti = 'jiçasti?' (1,1,-1)
'And now then (what do we do)?'

x.ti.sti = 'jiçatisti?' (-1,1,1)
'And by any chance now then (has that happened)?'

The part implied in the expression appears between parentheses.

5.2.7.-/EAB/RAT/17 (L, P)

ME: 'aka warmeј jarisa payisa.' (connective without connective term).

"This woman either washes /clothes/or cooks" (what speaker intended to say) (JJE-197).

Because the sender has omitted the connective "uka.A" , the receiver is forced to assume any of at least three possibilities:

MRI: 'aka warmeј jarisa payisa ukkasa.'

'La mujer ésta ya sea que lava o cocina

"This woman either washes or cooks (perhap both, but one for certain)."

MR2: 'aka warmeј jarisa payisa ukaspi.'

'La mujer ésta ni lava ni cocina ni siquiera pues.'

'This woman neither washes nor cooks for sure'

MR3: 'aka warmeј jarisa payisa janit ukjamaça?'

'La mujer ésta acaso no lava ni cocina entonces?'

'This woman by any chance does not wash or cook then?'

The stochastic alternative is also equivalent (in the bivalent part):

'aka warmeј jarisalla payisalla ukasti.'

'La mujer ésta tampoco lava, tampoco cocina entonces.'

'This woman neither washes nor cooks then'

Using the operational method explained in the last chapter, it is easy to see that the Spanish interpretations of the above-mentioned statements are in accordance with their respective truth-tables:

x=	1	0	1	1	0	-1	1	0	-1
y=	1	1	1	0	0	0	-1	-1	-1
x.sa+y.sa+xy.ka.sa =	0	1	1	1	1	-1	1	-1	-1
x.sa+y.sa+xy.sa.pi=	-1	-1	-1	-1	-1	0	-1	0	1
x.sa+y.sa+xy.ti ça =	1	-1	-1	-1	-1	0	-1	0	0

To verify the calculations the reader must keep in mind that

xy.A is (xy).A.

The fact that the same logical suffix can be used to generate various kinds of connective statements has always baffled linguists, who have a bivalent bias and prefer clear, "unambiguous" functors. For example, in his grammar, M. Hartmann goes so far as to say there are no functors in Aymara: In his grammar, Tarifa uses the adversative conjunction "neither" to translate the logical suffix "sa", whereas Ebbing prefers the alternative conjunction "or", and Middendorf, "and."

5.3.-Inferences under conditions of uncertainty

When faced with a reasoning problem involving a set of premises from which one or several conclusions must be reached following a process of logical inference, usually one follows a previously known logical model which suits the particular case.

To be able to use an adequate logical model which will lead to the desired conclusion, following a given inferential schema, the problem must be phrased as an inference, i.e., a system of equations with the propositional variables which represent the statements forming the given premises and the conclusions we want to reach. In everyday life, most inferential problems involve giving and receiving instructions which can be expressed in simple terms and handled by the syntax of the language. These inferences are so common that their mere enunciation leads us almost automatically to the conclusion.

For instance, if a contract stipulates that "if A works, then B will pay him", it stands to reason that if this does not happen, it is because A has worked, but B has not paid him. Some people may be "more logical" than others and able to handle more complex problems involving several statements: in any event, the valid formulation of logical problems depends on the correct use of connective words according to the syntactic rules of the language.

When we enter the realm of modal logic, where statements cannot be worded with total precision using everyday language, one must resort to symbolic logic, and use formulas to phrase inferential problems. However, as seen in previous chapters, Aymara syntax makes it possible, using logical suffixes, to understand a great many modal statements in an unequivocal manner. Now; to determine the degree to which an "Aymara-thinking person" can infer conclusions, without resorting to mathematical symbols, is outside the scope of our research on Aymara logic. It is evident that this language has tremendous possibilities because modal statements can be consistently expressed in very compact form. This makes it possible to retain in memory numerous inferential schemata which sometimes cannot even be expressed in other languages.

It is also true that in Spanish people do not always use all the available possibilities to phrase statements precisely, and to infer conclusions "mentally", that is to say, without recourse to pen and paper. For instance a survey among educated people would show that a large percentage of them do not know how to clearly differentiate between the alternative " p or q " and the disjunctive "be it either p or q ", even within the limited framework of bivalent logic. This lack of distinction between the connectives of language can even be seen in scientific documents where the neologism "and/or" has been introduced; there is only one truth-table that can be assigned to it: the one corresponding to the alternative conjunction "or".

It is not surprising therefore, that uneducated people are unable to avail themselves of all the possibilities offered by a language as logical and powerful as Aymara. Socio- linguistic research would help to determine to what extent Aymara-speaking people really make use of all the logical possibilities of their language.

The sentences in the examples which appear in previous chapters have almost all been taken from grammar books which record Aymara as it is actually spoken. These examples have been very useful to show the logical structure embedded in the syntax of this language, the mathematical properties of which have been presented. Hereafter, we are on our own. It is not my intention to invent examples in Aymara to study three-valued logic; however, I will try to generate statements which express inferences, always strictly respecting the grammatical rules of Aymara and applying the results of my research on the functions of logical suffixes.

Readers who learned Aymara in childhood can check the validity of these formulations, and determine whether they allow them to "mentally infer" mathematically demonstrable conclusions. These formulations have been translated as accurately as possible and are provided to enable all other readers to appreciate the approximate meaning of those statements; in all instances the corresponding truth-values and algebraic calculations which prove the validity of our results are given.

Since our goal is to investigate the potential value of Aymara logic for inferential analysis, our efforts will be directed mainly at problems which cannot be solved by using Aristotelian logic. Specifically, we wish to show the advantages of Aymara logic for solving inferential problems involving uncertain premises, while emphasizing the practical value of this approach. For example, let us analyze a classical problem of inference as seen from the perspective of an Aymara.

Discussion on logic between a Greek and an Aymara on Olympus

Once upon a time, **Aristotle**, the founder of Greek logic, disciple of Plato, member of the court of Philip of Macedonia, tutor to Alexander the Great, went for a walk in one of the beautiful spacious gardens of Olympus. His curiosity was suddenly aroused by an Indian woman, possibly named **Çoqewanqa**, a native of Taypi Qala. She was sitting on the ground thinking, her attention concentrated on a row of kuka (coca) leaves which were laid out in front of her. They engaged in the following conversation:

Aristotle: Say, my good woman, why are you so absorbed with those leaves?

Çoqewanqa: Ah! Hiya, pop, how do you like my game?

Aristotle: Game? Come now! Tell me what sort of game you are playing on the ground.

Çoqewanqa: This is a logical matrix, pues/for sure/; it helps me infer from these premises the value of that conclusion (she points to the rows)

Aristotle: Are you telling me you cannot think logically, and therefore you must resort to such a primitive aid to make simple inferences?

Çoqewanqa: Hey, mister, do you think this is a simple inference? Can't you see there are so many compound premises I can't remember all of them at the same time? My leaves help me to calculate the result without having to wrack my brains. Now, tell me, mister, could you do it without help?

Aristotle: Are you trying to solve a syllogism?

Çoqewanqa: Syllogism? What's that? Explain what ya mean!

Aristotle: Well, I think that before we get down to business we must check whether you and I can converse on logical matters. I will pose a simple problem of inference; if you can solve it, we can proceed. If you can't, it's of no use trying.

Çoqewanqa: OK man, let's go.

Aristotle: Can you see the two gentlemen chatting by that tree? Well, one is Plato and the other is Socrates, two great philosophers who, as you surely know, made enormous contributions to mankind.

Çoqewanqa: I dunno that.

Aristotle: Well, now you know. All right now. Socrates once told Plato: "I won't want to visit you unless you want to visit me." Plato replied saying: "I won't want to visit you if you want to visit me, but I will want to visit you if you do not want to visit me." Now, tell me, what did Socrates and Plato want?

Çoqewanqa: That's really simple, you know. No wonder you don't use coca leaves for that. The Socrates doesn't want to visit the Plato ... On the other hand, the Plato wants to visit the Socrates nomás /probably/

Aristotle: Well done, cunning Indian! I see you can think straight. Let's go on.

Çoqewanqa: Wait a second mister! Now it's my turn to pose a logical problem to make you think.

Aristotle: I see you don't know how to show respect, but all right, I'll listen to you.

Çoqewanqa: The problem is almost identical to the one you gave me, the only difference is: 'Socratej janit Platunaru tumpasiniña munkitiça Platonej Socratesaru tumpasiniña munaspallaça tullanska'.

Aristotle: What the hell is that? What language are you speaking?

Çoqewanqa: Hey man, you are really ignorant! Didn't you know that we Qoyas already spoke Aymara long before you were born? What I said to you is that, in this case, the first premise is: "be the Socrates perhaps will not want to go visit Plato, or be the Plato will not really want to visit the Socrates, but."

Aristotle: (after thinking for quite a while). If I have understood you correctly, what you are trying to tell me is that now the premise is: "It is questionable that Socrates wants to visit Plato, although it is possible the latter still wants to visit Socrates". Right?

Çoqewanqa: That's good. You have said it beautifully, more or less, but. Now go on with that inference of yours.

Aristotle: Although you have been able to phrase a premise involving modal statements and, I must admit, you have formulated a hitherto unstudied modality, viz, the probability modality, you seem unaware that one cannot arrive at a conclusion this way. How can one arrive at something certain from something which is only probable?

Çoqewanqa: Not long ago, a young man by the name of Jan Lukasiewicz arrived in Olympus. He uses formulate to arrive at conclusions from modal premises. Perhaps he can help you, maybe.

Aristotle: I am aware of the papers on three-valued logic published by that Pole, but his mathematical notation is not widely accepted. Don't tell me you know it already!

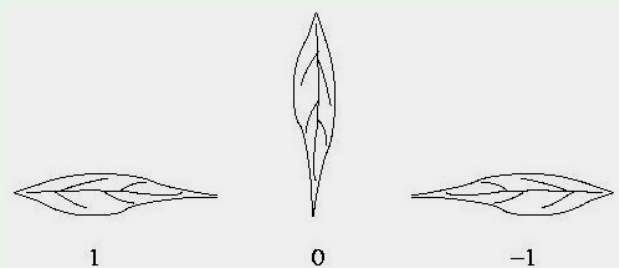
Çoqewanqa: I only know how to infer using my coca leaves, which I place in order according to the suffixes used in Aymara to set out premises and conclusions. I can teach you if you want, but.

Aristotle: OK. Let's see what can be done by those Qoya people you are so proud of. Show me how one can infer the conclusion of the problem you posed.

Çoqew: It's really easy! My result is just the opposite of the former one, see! No doubt in this case the Socrates wants to visit the Plato, but the Plato doesn't want to visit the Socrates.

Well, **Aristotle** of Stagira was perplexed by the unequivocal demonstration made by **Çoqewanqa**, who used her coca leaves to display the truth-table shown below.

When using coca leaves, the three truth-value are represented by these three positions of the leaf:



Each row of leaves is a pakimsaku for each proposition made up of two simple statements which, in our case, are:

- x = 'Socrates wanted to go visit Plato'
- y = 'Plato wanted to go visit Socrates'

The modalities used by **Çoqewanqa** can be expressed formally:

$p = x.ti.ka$ = 'It is controversial that it is false that Socrates wants to go to visit Plato'

$q = y.su.lla$ = 'It is improbable that Plato possibly wants to go to visit Socrates.'

Thus, the first premise is the alternative which can be written

- $p \vee q = x.ti.ka.ti.ça + y.su.la.ça + xy.la.ska$

"Be that it is p , unless it is q "

The following truth-tables correspond to both versions of the problem, *Aristotle's* and *Çoqewanqa's*:

<i>Aristotle's</i>									
$x =$	1	0	-1	1	0	-1	1	0	-1
$y =$	1	1	1	0	0	0	-1	-1	-1
$P1: (-x) \vee y =$	1	1	1	0	0	1	-1	0	1
$P2: x = > (-y) =$	-1	0	1	0	0	1	1	1	1
$P3: (-x) = > y =$	1	1	1	1	0	0	1	0	-1

<i>Çoqewanqa's</i>									
$p = x.ti.ka.ti =$	1	-1	0	1	-1	0	1	-1	0
$q = x.su.la =$	-1	-1	-1	-1	-1	-1	0	0	0
$P1: p \vee q =$	1	-1	0	1	-1	0	1	0	0
$P2: x = > (-y) =$	-1	0	1	0	0	1	1	1	1
$P3: (-x) = > y =$	1	1	1	1	0	0	1	0	-1

It should be pointed out that in both cases the premises of implication (P2 and P3) are identical and are not modal. However, premise P1 differs in the two versions, and in *Çoqewanqa's* version it is a modal premise. The conclusion appears in the column in which all premises are met. As can be seen, in *Aristotle's* version in the third column, $x = 1$, $y = 1$; whereas in *Çoqewanqa's*, it is in the seventh column, $x = 1$; $y = -1$.

(1) Translator's Note: The terms "level", "channel", etc. used in this section are those used by IGR in the Spanish original.

CHAPTER SIX

PROSPECTS FOR RESEARCH ON AYMARA LOGIC

There are promising possibilities for future research on Aymara logic. Both scientific and practical endeavors could benefit from the results already available and from expected findings following further study of the subject.

1) In the field of social communication, a more complete collection of cases of misunderstanding occurring various levels and channels could be very helpful to teachers and text writers, both Spanish and Aymara.

2) The bilingual literacy campaign must take into account the role played by logical suffixes in Aymara. These suffixes are worthy of consideration, and may even have an impact on the orthography to be used. It should be pointed out that the efficiency and achievement attained by bilingual programs all over the world is greater than that of unilingual campaigns.

3) Aymara syntax is strictly algorithmic, which could provide a marvelous opportunity for the use of computerized automatic translation techniques. This, in turn, could have a very positive effect on the revitalization of the Aymara language, as well as on the education of Aymara-speaking people in Bolivia and Peru.

4) The techniques derived from a thorough study of the relationship between Aymara logic and syntax could be very enlightening for the elaboration of new computer languages. Perhaps Aymara could be used directly for this purpose.

5) Computer science might benefit from mathematical research in the field of "Aymara siwi." It should not be forgotten that trits have a higher encoding power than bits. Information storage density in a trinary memory would increase logarithmically if it were possible to manufacture trinary electronic elements based on trits; for example, flow in one direction = 1, flow in the opposite direction = -1, and no flow (doubt concerning direction) = 0. It is evident that four trinary elements can store $3^4 = 81$ different code words, whereas four binary elements can store only $2^4 = 16$. In other words, a computer having a trinary memory, and programmed according to Aymara logic, would be much more powerful than present-day binary computers based on Boolean algebra.

6) In the field of logic itself, the study of Aymara logic will unquestionably be fascinating. It is a complete inferential theory in every sense of the term: on the one hand it affords a consistent treatment of modal logic; on the other hand, it has an algebraic structure, the "Aymara siwi", which makes it possible to calculate any correctly formulated inferential problem, even when starting from modal premises. Even the temporality of statements is syntactically related to the modal aspect, so that all the tools needed to formulate an integral theory of inference are present.

7) In the field of neurology, it would be interesting to find out whether the information encoding process in our neurons is binary or trinary. If it were trinary, the logical circuits in our brain could be understood using the "Aymara siwi"; thus, Aymara could become the natural "compiler."

8) In the field of decision-making theory, it would be very valuable to investigate the applications of Aymara inferential schemata by which it is possible to reach conclusions starting from uncertain premises. This would permit strategies to be designed based on probabilistic concepts within a trivalent logical schema.

9) In the fields of anthropology and linguistics, there are serious doubts as to the origin of the Qoya culture and its relationships with several other ancient cultures worldwide. For example, if other languages having syntactic structures involving a trivalent system of logic were found, the classification of language families would benefit enormously. Semantic comparisons have suggested that the Qoya languages are closely related to the Turkish-Mongolian family (BM-31; MNA). On the other hand, Bouda (KB2) has identified relationships between Aymara and Caucasian. The comparative analysis of logical aspects of languages could throw new light on those theories.

appendices

A.

Number of People who speak Aymara in Bolivia (Statistics obtained by the I.N.E., 1976 census)

Department	Unilingual Aymara	Bilingual Aymara/ Aymara/Queshua	Trilingual A / S / Q	Total Aymara-speaking	Total Population
La Paz	276,547	603,762 6,947	32,392	919,648 (62.77)	1,465,078
Oruro	23,971	50,524 10,969	35,641	121,105 (39,01)	310,409
Potosi	9,335	8,643 29,140	19,250	66,368 (10,09)	657,743
Cochabamba	4,461	7,763 5,140	8,840	26,204 (3,63)	720,952
Santa Cruz	460	6,339 203	4,638	11,641 (1,64)	710,724
Chuquisaca	251	745 254	838	2,088 (0,58)	358,516
Tarija	96	899 20	729	1,744 (0,93)	187,204
Beni	94	1,251 10	293	1,648 (0,98)	168,367
Pando	12	92 1	48	153 (0,44)	34,493
TOTAL	315,228	680,018 52,684	102,669	1,150,599 (24,9%)	4,613,486

B.

Changes in the number of Aymara Speaking people in Bolivia (1854-1976)

Department	Aymara-Speaking	1854 Census (%)	Total	Aymara-Speaking	1976 Census (%)	Total
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La Paz	359,752	(84.1)	427,972	919,648	(62.8)	1.465,079
Oruro	82,994	(90.9)	91,254	121,105	(39.0)	310,409
Other Departments	(Estimate: 0)		(no data)	109,846	(3.9)	2.837,999
TOTAL	442,746	--	(no data)	1.150,599	(24.9)	4.613,486

The data for the 1854 Census are from E.W.Middendorf's "Aymara Sprache". The 1976 Census data were supplied by the Instituto Nacional de Estadística (INE), La Paz, Bolivia.

Analysis: The data show that total population has grown 3.4 times, whereas the number of Aymara-speaking has only grown 2.6 times. This indicates a certain decrease, probably due to "Hispanicization" campaigns. On the other hand, the number of Aymara-speaking people in other departments (outside La Paz and Oruro) has increased since 1854.

C.

Aymara and Illiteracy

Aymara-speaking people			
Department	Some years of schooling	no schooling	Total
La Paz	587,411	332,237	919,648
Oruro	79,896	41,209	121,105
Potosi	27,203	39,165	66,368
Cochabamba	15,701	10,503	26,204
TOTAL	710,211	423,114	1.113,325
%	63.79%	36.21%	100%

From table p12, 1976 Census, Instituto Nacional de Estadística (INE), La Paz, Bolivia.

D.

Symbols used for the sounds of Aymara (by different authors)

	Bertonio	Middendorf	Ebbing	Cala	Maryknoll	Yapita	IGR
Phoneme:							
Postvelar occlusive	ca que co	ca que co	k'	ka que ko	q	q	q
simple	caa qhe cco	'ka 'ke 'ko	kj	kha khe kho	qh	q"	^q
aspirate	ka ke ko	ka' ke' ki'	kk	k'a k'e k'o	q'	q'	`q;
plosive							
velar occlusive	ca qui co	ca qui qu	k	ca qui co	k	k	k

simple aspirate plosive	cca qhi khu ka ki ku	'ka 'ki 'ju ka ki ku	kh kk	qha qhi qhu c'a c'i c'u	kh k'	k" k'	^k `k
<u>velar fricative</u> simple strong aspiration	ha hi hu kja kje kjo	'ha 'hi 'hu 'ja 'je 'jo	j, h jj	ja ji ju jja jje jjo	j jj	j x	j ^j
<u>palatal affricate</u> simple aspirate plosive	ch chh cch	ch c'h ch'	ch chh chch	ch chh ch'	ch chh ch'	ch ch" ch'	ç ^ç `ç
<u>bi-labial occlusive</u> simple aspirate plosive	p ph pp	p 'p p'	p ph pp	p ph p''	p ph p'	p p" p'	p ^p `p
<u>dental occlusive</u> simple aspirate occlusive	t th tt	t 't t'	t th tt	t th t'	t th t'	t t" t'	t ^t `t
<u>pseudo-vowel</u>	hu	hu	w	w	w	w	w

E.

A short glossary of Aymara which shows the formation and phonemics (sic) of some words

yatiña to know	uta building, house
yatiñaj knowledge	utaña (to) build
yatiñawi science	yatiña (to) teach, "to make wise"
yatiña wisdom	yatiñiri teacher, the one who teaches
yatiña qanña essence, substance of wisdom; "sapiencia" / Bol. for sapience/	yatiñawi school, place where teaching is normally done
yatiri essence, substance of wisdom; "sapiencia" / Bol. for sapience/	yatiña (to) learn
yatiñakama wisely	yatiñeri learner, pupil
yatiñawikama scientifically	qanña (yo) be (ontologic sense)
yatiñawi kamana scientific	qanña^j being
yatiñawi qanña essence of science, "scienticity"	qanqata character
una object	qanqawi characteristic
unanña (to) know, to apprehend the object, to know about something	qanña (to) exist
unanñaku knowledge	qanñaawi existence
unanñiri the one who knows (something special)	utña there be; to be available
yatisiña (to) use to (do something), "saberse", "poderse" / Bolivianisms/	utji there is (are)
uma water	janiw utjkiti there is (are) not
umaña (to) drink	kanka roast
umaña yatisi he is used to drinking	kankaña (to) roast
umata drunk, tipsy	kankata roasted
umawi drinking trough, watering place	-wa (to) be, copulative verbal suffix
yatiña to let know, (to) inform	ja`ça big
unanña to make something know	ja`cawa it is big
umayña to make (somebody) drink	qanñaça janiña tullanska, maa jis^kiwa. <u>IGR gives this translations in English:</u> (To be or not to be is a question)
	janiw qanqamna^ja?, ya^qa jis^kiwa ("by any chance it is not that it is") by any chance is it not?, is another question)

-mna
verb ending for the general person (sic)

saña
(to) say

samna
people say

luraña
(to) do, make

luramna
people do

yatimna
people know

qala
stone qalaqera (uqarry, place where one gets stones)

qala qala
stony or rocky ground

qalanaka
several stones, stones

qalarara
stony, rocky

qalaçaña
(to) turn into stone

qalaçasña
(to) be petrified

qalaptaña
(to) become hard as a rock

qalaçaña
(to) pave

qalançaraña
(to) unpave

qolla
medicine, medicinal drug

qollaña
(to) cure with medicines

qolliri
physician (some one who cures using medicine)

qolla kamana
pharmacologist, the one who prepares medicines

qora
grass

qolla qora
medicinal herb

qora qora
pasture, place where where there are many grasses(or herbs)

qoqa
tree

qoqa qoqa
forest

kuka
coca, coca plant

kuka kuka
coca plantation

qoya
original ancestry of andean cultures

suyu
space, territory

qoya suyu
Qoya territory

qoya^j
woman, queen of Qoya stock

qoya jaqe^j
Qoya man

jaqe
man, woman, human being

warmi
woman

çaça
man, male

wawa
young (of man, animals and plants)

çaça wawa
little male

warmi wawa
little female

asu
newborn baby

asu wawa
newborn animal

asu
tender, young

tayna
first-born (either male or female)

taynaña
(to) give birth for the first time

tayniri
woman who is giving birth for the first time

wawaçasña
(to) give birth

wawaçasiri
woman who is giving birth

qallu
young, kid, pup

qaçu)(orqo
female) (male

la`pa
louse

la`paña
lousy

^Kuçi
pig, hog

^Kuçiña
"puerquienta", swine (word of Aymara origin)

^Kuçiqerari
pigsty

Kusi
happy

Kusiña
to) make (someone) happy

Kusisiña
(to) be happy

^kayma
apathetic

^kaymasiña
to) become apathetic

^kari
liar

^karisiña

(to) lie / to oneself /

`qelli

resentful, (to) feel rejected, not to get attention

`qelliña

(to) bear someone resentment, to be annoyed with someone

`qellisiña

(to) become resentful of, to resent

`qellu

yellow

`qellurata

yellowish

`çima

violet (colour)

`çima^ka

violaceous

^qella

ash

^qellaka

ashy

^qellawi

ashtray

^kata

lime

^katawi

limestone quarry

qata

place

nayra qata

first place

nayra qatankaña

(to) be in first place

`qata

too tight, "muy apreto" / Bolivianism /

kaka

grey hair, faded

^ka^ka

stutterer

qaqa

cavern, deep cave

^qa^qa

cooking stove

^qana

light, clarity, clear

qana

fishing net

^kana

plait (or braid)

jama

manner, mode

ukjama

thus (that way)

ukjamawa

it is so

qaljama

like stone

jaqjama

human-like

kunjamasá?

what does it look like?

kami

how

kamisá?

how is it?

^jama

excrement, scum, dregs

^jamjama

like excrement

kamisáki?

how are you? ("cómo es nomás") / Bolivianism /

waliki

well NOMAS

wali

well

tanta

meeting, reunion

tantaña

(to) get together

tantasiña

(to) meet

tantanaku

"(to) like together", "matching"

`tan`ta

bread

`tan`taçaña

to make bread

`tan`taçiri

baker (one who likes making bread)

`tan`ta kamana

baker, (one who makes a living from bread making)

^tan^ta

old, torn, outdated thing

^tan^talli

ungraceful, wracked, destroyed

^tan^tawalla

poor man, person dressed in rags

^qatu

market, stall

`tan`ta ^qatu

place where bread is sold

^tan^ta ^qatu

flea market

`çama

strength

`çamani

strong (who has strength)

`çama ^ktara

strong man (who is very strong)

sinti

strong, intense

sintikama

strongly

^çama

that is not well ground or milled, half ground

çeqa

right

`çeqa)(kupi

left) (right

^çeqa
 wing
jupa
 he or she
ju^pa
 quinoa
para
 front
`para
 flight, scare
^para
 dry, lacking in water
uru
 day
oro
 vault, a hill shaped like a vault
oro oro
 place where there are many vault-shaped hills (Oruro)
tutu
 great
tutu sariri
 good walker, wanderer, mast, pole
toto
 mast, pole
qollo
 mountain
qollo qollo
 mountain range
qollu
 waste (of time)
uru qollu

wasting the day
ayllu
 geographical and cultural environment in which
 somebody was born
ayllo
 bolas (weapon which consists of several roped tied
 together with
mori
 wet, that has absorbed water
muri
 desperate, disconsolate
man`qa
 food
man`qaña
 (to) eat
man`qasiña
 (to) eat together
man`qafapiña
 (to) eat (several people together)
man`qantaña
 (to) gulp down, to gobble up
man`qsuña
 (to) eat (everything, to leave nothing on the plate)
man`qayaña
 (to) meke someone eat (to) help someone to eat)
man`qaçukiña
 (to) pretend one is eating
man`qawi
 eater

FILE B0

DOCUMENTATION ON AYMARA AND RELATED SUBJECTS, PREPARED BY:

IVAN GUZMÁN DE ROJAS

KEY	NAME OF	MATER	TITLE OF DOCUMENT
AA1	Alcides	N	Wata Wara
AA2	Alcides	N	Raza de Bronce
ACB	Almudena	A	Contribución a la Biografía del Aymara y Quichua
ACDT	Arturo	A	Las Academias Aymaras Bolivianas del Pasado y Present
AD1	Alfredo	M	Introducción a la Lógica Formal (Vols. 1 y 2)
ADV	Antonio	H	Leyendas de mi tierra
AE	Alberto	G	Lingüística y Política
AF1	Alfonso	B	La Poesía Aymara
AG	Augusto	H	Tupaj Katari
AGP	Alfredo	E	La Educación del Indio
ALIP	Alejandro	G	Indoamericanismo y Raza India
ANPC	Antonio	L	Reframes, Frases y Expresiones Populares de Bolivia
AP1	Arthur	H	Eline Praehistorische Metropole in Sudamerica
AP2	Arthur	G	Antropología de las Rezas Interandinas y Adjacentes
APC	Alfonso	L	Diccionario del Cholo Ilustrado
APC1	Antonio	G	Costumbres Matrimoniales Indígenas
APC2	Antonio	N	Cuentos Populares Bolivianos
APC3	Antonio	N	Antología de Tradiciones y Legendas Bolivianas
APC4	Antonio	L	Refranes, Frases y Expresiones Populares de Bolivia
AT	Alfredo	H	Lingüística e Historia en Los Andes de Perú y Bolivia
AU	Arturo	G	Las comunidades Indígenas en Bolivia
AVV	Alipio	H	Julian Tupaj Katari
B&B	H.C.	G	Bolivian Aymara
B&B	I.M.	M	Grundriss Der Logic
BM	Bertil	L	Los Nuevos Caminos de La Lingüística
BPM1	Blanca	B	Versos en Aymara
BPM2	Blanca	B	Himnos Patrióticos y Canciones en Aymara
BS	Bárbara	F	Nade Nee - Guaraní para Castellano-Hablantes
BWC	Wendell C.	H	Andean Culture History
CALA	Comisión de	A	Diccionario (Aymara-Castellano-Aymara)
CFB	Carlos Felipe	A	Opúsculos para la Civilización del Indio
CGR	Cecilio	H	La Estética en el Qoya Suyu
CHM	Clemente H.	A	La Impropiedad del Nombre 'Aymara'

CIP1	Cipca	G	Los Aymaras Dentro de la Sociedad Boliviana
CIP2	Joseph Ma.	H	Apuntes para una Historia Aymara
CM1	Carlos	N	La Chaskanawi
CPS	Carlos	H	La Cultura Nativa en Bolivia
CPS1	Carlos	H	Tiwanaku, Espacio Tiempo y Cultura
CPS2	Carlos	H	Origen del Dualismo Cultural en Bolivia
CRU	Carlos	F	La Dialectología Tzeltal y el Diccionario Compacto
CVC	Christos	A	Esquisse Phonolosique de L'Aymara Parle AU Chili
DDM	F. Diego	H	Crónica de la Ptovincia S. Antonio de los Charcas
DF	David	G	On the Aymara Indians of Bolivia and Peru
DTR	Diego	A	Arte de la Lengua Aymara (Gramática y Vocabulario)
EC&	E. Coumet	L	Lógica y Lingüística
EDAF	Varios	L	Lecturas de Socio Lingüística
EDM	P. Ernesto	F	Idioma Mapuche (Araucano)
EHM	Eusebia Herminia	A	Los Préstamos del Español en el Aymara de Compi
EIG1	Dick Edgar	H	Prehistoria de Bolivia
EIG1	Dick Edgar	H	La Verdadera Historia de los Incas
EJ	Elizabeth	B	Ofrenda de Agradecimiento a la Terra
EOP	Enrique	G	Cultura Callawaya
EP	Eliardo	E	La Escuela-Ayllu
ETA	Erasmus	A	Suma Lajjra Aymara Parlana (Gramática Aymara)
ETA1	Erasmus	E	Educación y Alfabetización en Lenguas Nativas
EVR	Emeterio	A	La Lengua de Adán (Reedición con Biografía del Autor)
EWM	Ernst Wilhelm	A	Die Einheimischan Sprachen Perus
EWM1	Ernst Wilhelm	C	Gramática Keshua
EWM5	Ernst Wilhelm	A	Die Aymara Sprache
EWM7	Ernst Wilhelm	G	Peru, Beobachtungen und Studien (Land U. Bewohner)
FA	Federico	G	Tierra y Alma de Bolivia
FARG	Fray Alonso	H	Historia de Nuestra Señora de Copacabana
FDM	Fernando	N	Ollanta El Jefe Kolla
FDST	Fray Domingo	C	Lexicon o Vocabulário de la Lengua General del Perú
FLP	Félix	A	Vocabulario Aymara de Emeterio Villamil de Rada
FLP1	Félix	A	Vocabulario Aymara de José María Camacho
FLP2	Félix	A	Desarrollo del Alfabeto Aymara
FMS	Fernando de M.	A	Nociones de Gramática Aymara (con vocabulario)
FR&	F.	G	Anthropometric Variations in Aymara (Genetics)
FT	Franz	E	La Cresción de la Pedagogía Nacional
GAO	Gustavo Adolfo	G	Figura y Carácter del Indio
GF	Guillermo	N	Los Mitos Profundos de Bolivia
GGV	Germán G.	A	Moderno Vocabulario del Quechua y del Aymara
GI1	P. Gregorio	G	Los Mineros Bolivianos
GI1	P. Gregorio	G	El Cooperativismo y la Comunidad Indígena
GIS	Casa	A	Catálogo de la Voces Usuales de Aymara
GLB1	Gregorio	G	Acerca de la Agricultura Aymara
GLB2	Gregorio	G	Organización Social Aymara
GPLMT	Giacomo	R	La Mitología en la Vida de los Pueblos
GPR	G	G	Aymara-Quechua Relations in Puno

HBR	Hugo	H	La Increible Ciudadela Prehispánica de Iskanwaya
HLO1	Hugo	A	Chokeyapu (Nombre de la Ciudad de La Paz)
HMC	Héctor M.	M	La Ciencia Matemática de los Mayas
HP	H.	G	Aymara of Western Bolivia (Dentition)
HR1	Hellen	A	Rudimentos de Gramática Aymara
HR2	Hellen	A	Manual Aymara para los Aymaristas
HSF	Hernando	L	El Habla Popular de Santa Cruz
HSK	H.S.	G	Demographic Study of Aymara (In 1786)
IBC	Instituto	G	Anales Primera Reunión de Antropología (Area Andes)
IDRC	International	E	The World of Literacy
IGR1	Ivan	A	La Lógica Matemática y el Niño Aymara
IGR2	Ivan	A	La Estructura Lógica del Idioma Aymara
IGR3	Ivan	M	Niño Vs. Número
IGR4	Ivan	A	Lógico-Lingüística de la Comunicación en Aymara
IGR5	Ivan	E	Actitud Mental de Paternalismo y Autoritarismo
IIM1	Inst. de Idiomas	A	Lecciones de Aymara (Niveles I y II)
IIM2	Inst. de Idiomas	A	Diccionario Aymara/Castellano Castellano/Aymara
ILCA	Instituto de	B	Jayma
INE	Instituto NI.	R	Resultados del Censo NI. de Población y Vivienda 1976
INEL	Instituto NI. de	A	Diccionario Aymara-Castellano
JAG	Juan Antonio	A	Gramática Aymara sobre la Base de una Edición Antigua
JAM	Juan	G	Sociología Indigenal y Antropología Telurista
JC	Joan	R	Breve Diccionario Etimológico de la Lengua Castellana
JD	Juan	A	Etimologías Perú-Bolivianas
JDY	Juan de Dios	A	Vocabulario Castellano Inglés Aymara
JDY1	Juan de Dios	A	Enseñanza del Idioma Aymara como Segundo Idioma
JEE	Juan Enrique	A	Aymara-Gramática y Diccionario
JFCA	José Felipe	L	Diccionario del Folklore Boliviano
JFM1	José	M	Diccionario de Filosofía (I y II)
JFM2	José	M	Lógica Matemática
JL1	JAN	M	Estudios de Lógica y Filosofía
JL2	JAN	M	La Silogística de Aristóteles
JLA	Jesús	C	Diccionario Queschua-Castellano-Queschua
JLA1	Jesús	D	Quechwataki (Coplas Queschuas)
JLA2	Jesús	N	Leyendas Queschuas
JMR	Jorge	R	Geografía de Bolivia
JPH	John	B	Cristomp Jiquisinjjata
JVM	John V.	H	Un Reyno Aymara en 1567
KB1	Karl	C	Tungusisch und Ketschua
KB2	Karl	A	Aymara und Tschimu
LADC	Lindaura	N	Hullparrimachi
LB0	Ludovido	A	Arte de la Lengua Aymara
LB1	Ludovico	A	Vocabulario de la Lengua Aymara (Castellano-Aymara)
LB2	Ludovico	A	Vocabulario de la Lengua Aymara (Aymara-Castellano)
LB3	Ludovico	B	De la Vida y Milagros de Nuestro Señor Jesuchristo
LB4	Ludovico	A	Carta del P. Bertonio Al P. Francisco Rocco (24/01/1615)
LBA	Louis	G	L'Empire Socialiste des Incas

LBO	Lewis	H	La Rebelión de Tupaj Amaru
LEM	Le Editorial	A	Manual Trilingüe de Aymara Quechua y Castellano
LTB	Lucy T.	A	Critical Survey of the Literature on the Aymara Lang.
LVJF	Luisa	G	Cultura Aymara en La Paz - Tradiciones y Costumbres
MBG	Mariano	H	Tiwanaku
MEVS	María Eugenia	H	Testimonios del Cerco de La Paz (1781)
MGN1	Marcelo	C	Método de Quechua
MGN2	Marcelo	A	Método de Aymara
MJHB	Martha J.	A	Outline of Aymara Phonological/Grammatical Structure
MJHB1	Martha J.	A	Postulados Lingüísticos del Idioma Aymara
MJHB2	Martha J.	A	Jaqi: The Lingüístic Family
MMA	Mario	A	Raíces Semíticas en la Religiosidad Aymara y Kichua
MMA1	Mario	A	El Perfil de una Teoría
MNP	Marina	H	Eternidad en Los Andes
MPV	Miguel	F	La Llave del Huichol
MRP	M. Rigoberto	H	Tupac Catari
MRP1	M. Rigoberto	A	Vocabulario de la Lengua Aymara
MSM	Miguel	B	Maa Tiwulan Wawa Sutyapa
MU	Max	H	La Posición Histórica de los Aymaras en el Ant. Perú
NFN	Nicolás	L	Diccionario de Bolivianismos
NFN1	Nicolás	A	Notas del Verbo Aymara
NFN2	Nicolás	A	Notas sobre la Lengua Aymara
NFN3	Nicolás	G	Apuntes para una Psicología del Hombre Boliviano
NTT	Nestor	N	Manchay Puytu
NW	Nathan	H	Los Vencidos (La Conquista 1530-1570)
OS	Ortwin	F	El Maya-Chontal de Alcalá
PA&	Percy G.	C	Basic Queschua
PAR1	Porfirio	A	Terminología Médica Aymara
PMS	R.P. Pedro	A	Diccionario Breve (Castellano-Aymara-Castellano)
PP1	Pablo	A	Nouvelles Etudes Sur Les Langues Americaines
PRGCM	Paúl	A	Bibliographie des Langues Kitchua et Aymara
PW	Paúl	A	Beginning Aymara -A Course For English Speakers-
RBE&	R.B.	G	Growth and Development of the Chest in Aymara Indians
RBG	Raúl	N	Coca
RDBS	Roberto D.	F	Gramática del Lacandon
RP	Roberto	G	Sentido y Proyección del Kollasuyo
RR	Rafael	E	Caquiaviri
RR1	Rafael	G	Ed Ponguage
RS	Rafael	R	Manual de Gramática Española
SSB	Sociedad	B	Machak Testamento -Diosan Arunacapa-
SH	Susan	M	Lógica Divergente (Deviant Logic)
TDM	Teresa	E	El Niño Aymara Frente a la Educación Castellanizante
TK	Thomas	R	The Structure of Scientific Revolutions
TS1	Thierry	G	Los Aymaras y el Control Ecológico Vertical
TT	T.	L	Die Satzkomplexitat im Spanischen der Andelander
UMSS1	Departamento de	H	Repartimiento de Tierras por el Inca Huayna Capac
VDT	Vicente	E	Filosofía de la Educación Boliviana

VHT1	Vitalino	E	La Promoción de la Lengua Aymara en el Area Rural
VHV	Víctor Hugo	L	Coba: Lenguage del Hampa Boliviano
VMA	Víctor Manuel	L	El Habla Popular en la Literatura Costarricense
VMA1	Víctor Manuel	F	Lenguas Indígenas Costarricenses
VOA	Radio	L	Special English Work Book
VVR	Víctor	L	El Castellano Popular en Tarija
WEC1	William E.	G	Comunidades Aymaras
WEC2	William E.	G	Impossible Eliminar Consumo de la Coca en Bolivia
WW	Wolfgang	A	A Computerized Dictionary of Andean Languages
XA	P. Xavier	G	La Paradoja Aymara: Solaridad y Faccionalismo
XA1	Xavier	G	El Futuro de los Idiomas Oprimidos
XA2	Xavier	C	El Queschua a su Alcance
XA3	Xavier	C	Los Mil Rostros del Queschua
YBC	Yolanda	B	Repertorio Aymara en Antología de la Poesía Boliviana
YLS	Yolanda	A	Categorías Posicionales an Qeschua y Aymara
YYS	Yolanda	C	Gramática Qeshwa (Runa-Simi) con Programa Dosificado

FILE B1

DOCUMENTATION ON AYMARA AND RELATED SUBJECTS PREPARED BY: IVAN GUZMÁN DE ROJAS

KEY	NAME OF AUTHOR	MATER YEAR	TITLE OF DOCUMENT PUBLISHED IN
A		A	SOBRE EL IDIOMA AYMARA
LBO	Ludovico Bertonio	A 1603	Arte de la Lengua Aymara Roma por Luiz Zannetti
LB1	Ludovico Bertonio	A 1612	Vocabulario de la Lengua Aymara (Castellano-Aymara) Compañía de Jesús de Juli, Chuquito
LB2	Ludovico Bertonio	A 1612	Vocabulario de la Lengua Aymara (Aymara-Castellano) Compañía de Jesús, Juli, Chuquito
LB4	Ludovico Bertonio	A 1615	Carta del P. Bertonio al P. Francisco Rocco (24/1/1615) Archivos del Vaticano
DTR	Diego de Torres Rubio	A 1616	Arte de la Lengua Aymara (Gramática y Vocabulario) Imprenta de Francisco de Canto, Lima
EVR	Emeterio Villamil de Rada	A 1860	La Lengua de Adán (Reedición con Biografía del Autor) Ed. Camarlinghi, La Paz, Bolivia 1972
CFB	Carlos Felipe Beltrán	A 1889	Opúsculos para la Civilización del Indio Tipografía "El Progreso", Oruro, Bol.
EWM	Ernst Wilhelm Middendorf	A 1890	Die Einheimischen Sprachen Perus F.A. Brockhaus, Leipzig (6 Vol.)
EWM5	Ernst Wilhelm Middendorf	A 1891	Die Aymara Sprache F.A. Brockhaus, Leipzig
FMS	Fernando de M. Sanjines	A 1907	Nociones de Gramática Aymara (Con vocabulario). Ed. de Ismael Argote, LPB
PP1	Paulo Patron	A 1907	Nouvelles Etudes Ser les Langues Americaines F.A. Brockhaus, Leipzig
JAG	Juan Antonio García S.J.	A 1917	Gramática Aymara sobre la Base de uns Edición Antigua Litografía Artística, La Paz, Bolivia
JD	Juan Durant	A 1921	Etimologías Perú-Bolivianas Talleres Gráficos "La Prensa", La Paz.
CHM	Clemente H. Markhan	A 1943	La Impropriedad del Nombre "Aymara" Kollasuyo, Vol. 50,430,112, Umsa, LPB
NFN1	Nicolás Fernandez Naranjo	A 1951	Notas del Verbo Aymara Rev. Kollasuyo, Ed. Umsa, La Paz, Bol.
NFN2	Nicolás Fernandez Naranjo	A 1951	Notas sobre la Lengua Aymara Rev. Kollasuyo, Ed. Umsa, La Paz, Bol.
PRGCM	Paúl Rivet y G. Crequi-Monfort	A 1956	Bibliographie das Langues Kichua Et Aymara Vol. IV, 1940-1955, Paris Inst. d'Ethno

Cala	Comisión de Alfabetn. y Liter	A	Diccionario (Aymara-Castellano-Aymara)
		1957	Cala, La Paz, Bolivia
KB2	Karl	A	Aymara und Tschimu
	Bouda	1961	At. Morgenlandischen Gesellschaft BIII
GIS	Casa	A	Catálogo de la Voces Usuales de Aymara
	Gisbert	1963	Ed. Gisbert y Co. S.A., La Paz, Bol.
JEE	Juan Enrique	A	Aymara -Gramática y -Diccionario
	Ebbing	1965	Ed. Don Bosco, La Paz, Bolivia
ACB	Almudena	A	Contribución a la Bibliografía del Aymara y Quíchua
	Cavestany Bastida	1966	36 Congresso Internacional Americanista
PW	Paul	A	Beginning Aymara -A Course for English Speakers-
	Wexler	1967	University of Washington, Seattle, USA
ETA	Erasmus	A	Suma Lajjra Aymara Parlana (Gramática Aymara)
	Tarifa Ascarrunz	1969	Ed. Don Bosco, La Paz, Bolivia
HR1	Hellen	A	Rudimentos de Gramática Aymara
	Ross	1969	Mision Bautista Canadiense
WW	Wolfgang	A	A Computerized Dictionary of Andean Languages
	Woelck	1969	Languages Sciences, Univ. of Indiana
PMS	R.P. Pedro	A	Diccionario Breve (Castellano-Aymara-Castellano)
	Miranda S.	1970	La Paz, Bolivia
EHM	Eusebia Herminia	A	Los Préstamos del Español en el Aymara de Compi
	Martín	1971	Románica, La Plata
HLO1	Hugo	A	Chokeyapu (Nombre de la Ciudad de La Paz)
	Lanza Ordoñez	1971	Pumapunku/Inst. de Cultura Aymara LPB
MRP1	M. Rigoberto	A	Vocabulario de la Lengua Aymara
	Paredes	1971	Ed. Isla, La Paz, Bolivia
YLS	Yolanda	A	Categorías Posicionales en Qeshua y Aymara
	Lastra de Suárez	1971	Anales de Antropología, México, Vol. 7
ACDT	Arturo	A	Las Academias Aymarás Bolivianas del Pasado y Present
	Costa de la Torre	1972	Pumapunku/No. 6, Municipalidad de LPB
MGN2	Marcelo	A	Método de Aymara
	Grondin N.	1973	Rodríguez-Muriel, Oruro, Bolivia
JDY	Juan de Dios	A	Vocabulario Castellano Inglés Aymara
	Yapita	1974	Ed. Indicep, Oruro, Bolivia
MJHB	Martha J.	A	Outline of Aymara Phonological/Gramatical Structure
	Hardman de Bautista	1974	University of Florida
IIM1	Inst. de Idiomas	A	Lecciones de Aymara (Niveles I y II)
	Padres de Maryknoll	1975	Cochabamba, Bolivia
LEM	La Editorial	A	Manual Trilingüe de Aymara Quechua y Castellano
	Mercurio S.A.	1975	Ed. Mercurio, Lima Perú
CVC	Christos	A	Esquisse Phonologique de L'Aymara Parle Au Chilli
	Clair-Vasiliadis	1976	Presse Universitaires de France, Paris
HR2	Hellen	A	Manual Aymara para los Aymaristas
	Ross	1976	Junta de Publicaciones de la UBB

PAR1	Porfirio Alcon Rodriguez	A 1976	Terminología Médica Aymara Educación Popular para el Des., Oruro
IGR1	Iván Guzmán de Rojas	A 1978	La Lógica Matemática y el Niño Aymara Presencia (13/09/78), La Paz, Bolivia
IIM2	Inst. de Idiomas Padres de Maryknoll	A 1978	Diccionario Aymara/CAstellano/Aymara Cochabamba, Bolivia
INEL	Instituto NI. de Estudios Lingüísticos	A 1978	Diccionario Aymara-Castellano Instituto NI. de Estudios Lingüísticos
MJHB2	Martha J. Hardman de Bautista	A 1978	Jaq: The Lingüístic Family International Jour. of Am. Lingüístics
FLP	Félix Layme Oairumani	A 1979	Vocabulario Aymara de Emeterio Villamil de Rada Recompilaciones Vocabulares Ilca, LPB
IGR2	Iván Guzmán de Rojas	A 1979	La Estructura Lógica del Idioma Aymara Presencia (03/06/79), La Paz, Bolivia
LTB	Lucy T. Briggs	A 1979	Critical Survey of The Literature on The Aymara Lang. Latin American Research Rev. V.14, N3
MJHB1	Martha J. Hardman de Bautista	A 1979	Postulados Lingüísticos del Idioma Aymara Departamento de Lingüística/Umsa, LPB
MMA	Mario Montano Aragón	A 1979	Raíces Semíticas en la Religiosidad Aymara y Kichua Biblioteca Popular Boliviana de UH
FLP1	Félix Layme Pairumani	A 1980	Vocabulario Aymara de José Maria Camacho Ilca, La Paz, Bolivia
FLP2	Félix Layme Pairumani	A 1980	Desarrollo del Alfabeto Aymara Ilca, La Paz, Bolivia
GGV	Germán G. Villamor	A 1981	Moderno Vocabulario del Qechua y del Aymara Ed. Popular
IGR4	Iván Guzmán de Rojas	A 1981	Lógico-Lingüística de la Comunicación en Aymara Research Centre (IDRC) Ottawa, Canadá
JDY1	Juan de Dios Yapita	A 1981	Enseñanza del Idioma Aymara como Segundo Idioma Ed. Difusión/Ilca., La Paz, Bolivia

FILE B1

DOCUMENTATION ON AYMARA AND RELATED SUBJECTS, PREPARED BY:

IVAN GUZMAN DE ROJAS

KEY	NAME OF AUTHOR	MATER YEAR	TITLE OF DOCUMENT PUBLISHED IN
B		B	PUBLICACIONES EN AYMARA
LB3	Ludovico Bertonio	B 1612	De la Vida y Milagros de Nuestro Señor Jesuchristo Chucuyto, Ed. Francisco de Canto
AF1	Alfonso Finot	A 1972	La Poesía Aymara Pumapumku/Inst. de Cultura Aymara LPB
SBB	Sociedad Bíblica Boliviana	B 1974	Machak Testamento -Diosan Arunacapa- Sociedad Bíblica Boliviana, Cochabamba
BPM1	Blanca Patiño de Murillo	B 1977	Versos en Aymara Cordepaz, La Paz, Bolivia
YBC	Yolanda Bedregal de Conitzer	B 1977	Repertorio Aymara en Antología de la Poesía Boliviana Ed. Los Amigos del Libro, La Paz, Bol.
BPM2	Blanca Patiño de Murillo	B 1978	Himnos Patrióticos y Canciones en Aymara Imp. "Vision", La Paz, Bolivia
MSM	Miguel Santos M.	B 1978	MAA Tiwulan Wawa Sutiypa Cipca, La Paz, Bolivia
JPH	John Phillips	B 1980	Cristomp Jiquisinjjata Centro Bíblico - Traductor Cala-
EJ	Elizabeth Johannenssen/Tr: E. Tarifa	B 1981	Ofrenda de Agradecimiento a la Tierra Ed. Acuario, La Paz, Bolivia
ILCA	Instituto de Lengua y Cultura Aymara	B 1982	Jayma Ilca, La Paz, Bolivia

KEY	NAME OF AUTHOR	MATER YEAR	TITLE OF DOCUMENT PUBLISHED IN
C		C	SOBRE EL IDIOMA QESHUA
FDST	Fray Domingo De Santo Tomás	C 1560	Lexicon o Vocabulario de la Lengua General del Perú Ed. Inst. de Hist., S. Marcos, Lima, 1951
EWM1	Ernst Wilhelm Middendorf	C 1890	Gramática Keshua Cultura e História - Aguilar, 1970
KB1	Karl Bouda	C 1960	Tungusish und Ketschua Kunde des Morgenlandes 110 99-113

XA2	Xavier Albo	C	El Quechua a su Alcance 1964 Alianza para el Progreso
JLA	Jesús Lara	C	Diccionario Qeschua-Castellano-Qeschua 1970 Ed. Amigos del Libro
MGN1	Marcelo Grondin N.	C	Método de Quechua 1971 Oruro, Bolivia
YYS	Yolanda Santander Salas de	C	Gramática Qeshwa (Runa-Simi) con Programa Dosificado 1972 Editorial Arica S.A., Lima, Perú
XA3	Xavier Albo	C	Los Mil Rostros del Quechua 1974 Inst. de Estudios Peruanos, Perú
MMA1	Mario Montano Aragón	C	El Perfil de una Teoría 1975 Pumapunku/Inst. de Cultura Aymara LPB
PA&	Percy G. Aitken-Soux & R.H.	C	Basic Quechua 1977 Utha State University
D	D		PUBLICACIONES EN QESHUA
JLA1	Jesús D Lara 1975		Quechwataki (Copias Quechuas) Ed. Los Amigos del Libro

E		E	EDUCACION EN IDIOMAS AUTOCTONOS
FT	Franz Tamayo	E	La Creación de la Pedagogía Nacional 1910 La Paz, Bolivia
AGP	Alfredo Guillén Pinto	E	La Educación del Indio 1919 Ed. Gonzales y Medina, La Paz, Bolivia
RR	Rafael Reyeros	E	Caquiaviri 1937 Ed. Universo, La Paz, Bolivia
VDT	Vicente Donoso Torrez	E	Filosofía de la Educación Boliviana 1946 Ed. Atlántida, Buenos Aires, Argentina
EP	Eliardo Pérez	E	La Escuela-Ayllu 1963 Ed. E. Burillo, La Paz, Bolivia
ETA1	Erasmus Tarifa Ascarrunz	E	Educación y Alfabetización en Lenguas Nativas 1972 América Indígena. México/D.F. 32
VHT1	Vitalino Huanca Torrez	E	La Promoción de la Lengua Aymara en el Area Rural 1975 Pumapunku/Inst. de Cultura Aymara LPB
IDRC	International Development Center	E	The World of Literacy 1979 Int. Council F. Adult Educ., Canada
IGR5	Iván Guzmán de Rojas	E	Actitud Mental de Paternalismo y Autoritarismo 1980 "Ultima Hora", 7 Mar. 80, La Paz, Bolivia
TDM	Teresa Doria Medina	E	El Niño Aymara Frente a la Educación Castellanizante 1982 Tesis: Humanidades, Umsa, La Paz, Bol.

KEY	NAME OF AUTHOR	MATER YEAR	TITLE OF DOCUMENT PUBLISHED IN
F		F	SOBRE OTROS IDIOMAS AUTOCTONOS
EDM	P. Ernesto De Moesbach	F 1962	Idioma Mapuche (Araucano) Ed. S. Francisco, Padre Las Casas, Chile
CRU	Carlos Robles U.	F 1966	La Dialectología Tzeltal y del Diccionario Compacto Inst. NI. de Antropología e Hist., México
RDBS	Roberto D. Bruce S.	F 1968	Gramática del Lacandon Inst. NI. de Antrop. e Hist., México
VMA1	Víctor Manuel Arroyo	F 1972	Lenguas Indígenas Costarricenses Aula. Ed. Universitária, Costa Rica
OS	Ortwin Smailus	F 1975	El Maya-Chontal de Alcala Centro de Estudios Mayas, México
MPV	Miguel Palafox Vargas	F 1978	La Llave del Huichol Inst. NI. de Antropología e Hist. México
BS	Bárbara Schuchard	F 1979	Nade Nee - Guaraní para Castellano-Hablantes Santa Cruz de la Sierra, Bolivia
KEY	NAME OF AUTHOR	MATER YEAR	TITLE OF DOCUMENT PUBLISHED IN
G		G	ANTROPOLOGIA'SOCIOLOGIA Y TECNOLOGIA QOYA
DF	David Forbes	G 1870	On The Aymara Indians of Bolivia and Peru Jour. of The Ethnolog. Soc., London
EWM7	Ernst Wilhelm Middendorf	G 1893	Peru, Beobachtungen und Studien (Land U. Bewohner)
LBA	Louis Baudin	G 1928	L'Empire Socialiste des Inka L'Institut d'Ethnologie, Paris
ALIP	Alejandro Lipschutz	G 1937	Indoamericanismo y Raza India Ed. Nacimiento, Santiago de Chile
AP2	Arthur Posnansky	G 1938	Antropología de las Razas Interandinas y Adyacentes Instituto "Tihuanacu", La Paz, Bolivia
FA	Federico Avila	G 1943	Tierra y Alma de Bolivia Ed. La Colmena, Asunción, Paraguay
GAO	Gustavo Adolfo Otero	G 1943	Figura y Carácter del Indio Ed. Juventud, La Paz, Bolivia
RR1	Rafael Reyeros	G 1949	El Ponguaje Ed. Universo, La Paz, Bolivia
NFN3	Nicolás Fernández Naranjo	G 1960	Apuntes para una Psicología del Hombre Boliviano "Noesis", Rev. de la Umsa, La Paz, Bol.
EOP	Enrique Oblitas Poblete	G 1963	Cultura Callawaya Baho Auspicio del Min. de Edcn. Boliv

RP	Roberto Prudencio	G 1971	Sentido y Protección del Kollasuyo Revista "Kollasuyo"
AE	Alberto Escobar	G 1972	Lingüística y Política Instituto de Estudios Peruanos/9
FR&	F. Rothhamm & R.S.	G 1972	Anthropometric Variations in Aymara (Genetics) Amer. Jour. of Human Genetics, V24, N4
GLB1	Gregorio Loza Balsa	G 1972	Acerca de la Agricultura Aymara Pumapunku/Instituto de Cultura Aymara
GLB2	Gregorio Loza Balsa	G 1972	Organización Social Aymara Pumapunku/Inst. de Cultura Aymara LPB
LVJF	Luisa Valda de Jaimes Freyre	G 1972	Cultura Aymara en La Paz -Tradiciones y -Costumbres Imprenta y Librería "Renovación"
B&B	H.C. Buechler & J.M.	G 1974	Bolivian Aymara American Anthropologist, V76, N1
GPR	G Primov	G 1974	Aymara-Quechua Relations in Puno Int. Jour. of Comparatives Sociol. V15
HSK	H.S. Klein	G 1975	Demographic Study of Aymara (In 1786) Desarrollo Económico V15, N59
IBC	Instituto Boliviano de Cultura	G 1975	Anales Primera Reunión de Antropología (Area Andes)
TS1	Thierry Saignes	G 1975	Los Aymaras y el Control Ecológico Vertical "Presencia", La Paz, Bolivia
XA	P. Xavier Albo	G 1975	La Paradoja Aymara: Solaridad y Faccionismo Ed. Cipca, La Paz, Bolivia
CIP1	Cipca Cen Inv y Promn.	G 1976	Los Aymaras Dentro de la Sociedad Boliviana Cuaderno de Investigación Cipca/12
XA1	Xavier Albo	G 1977	El Futuro de los Idiomas Oprimidos Cipca, La Paz, Bolivia
G 1	P. Gregorio Iriarte	G 1978	Los Mineros Bolivianos Buenos Aires, Argentina
HP	H. Palomino	G 1978	Aymara of Western Bolivia (Dentition) Jour. of Dental Research, V57, N3
WEC1	William E. Carter	G 1978	Comunidades Aymaras Instituto Inndegenista Interamer., Méx.
WEC2	William E. Carter	G 1978	Impossible Eliminar Consumo de la Coca en Bolivia Semana de "Ultima Hora" 1 Dic. 78, La Paz
G 2	P. Gregorio Iriarte	G 1979	El Cooperativismo y la Comunidad Indígena Ed. Puerta del Sol, La Paz, Bolivia
RBE&	R.B. Eckhardl & J.S. Dutt	G 1979	Growth and Development of the Chest in Aymara Indians
APC1	Antonio Paredes Candia	G 1981	Costumbres Matrimoniales Indígenas Ed. Isla, La Paz
AU	Arturo Urquidi	G 1982	Las Comunidades Indígenas en Bolivia Librería Editorial "Juventud", LPB

JAM	Juan Albarracín Millán	G	Sociología Indígenal y Antropología Telurista Sociología Boliviana Contemporánea IV
1982			
KEY	NAME OF AUTHOR	MATER YEAR	TITLE OF DOCUMENT PUBLISHED IN
H		H	HISTORIA, ARTES Y ARQUEOLOGIA QOYA
FARG	Fray Alonso Ramos Gavilán	H 1621	Historia de Nuestra Señora de Copacabana
DDM	F. Diego De Mendoza	H 1663	Crónica de la Provincia S. Antonio de los Charcas
MRP	M. Rigoberto Paredes	H 1897	Tupac Catari Ed. Isla, La Paz, 1980
MU	Max Uhle	H 1910	La Posición Histórica de los Aymaras en el Ant. Perú
AP1	Arthur Posnansky	H 1914	Eine Praehistorische Metropole in Sudamérica
AG	Augusto Guzmán	H 1942	Tupaj Katari Ed. Juventud, La Paz, Bolivia, 1972
CGR	Cecilio Guzmán de Rojas	H 1942	La Estética en el Qoya Suyu "La Prensa", B. Aires (1942)
BWC	Wendell C. Bennett & Junius B.	H 1949	Andean Culture History American Museum of Nat. History, N.Y.
LBP	Lewin Boleslao	H 1967	La Rebelión de Tupaj Amaru Ed. Latinoamericana, B. Aires
CPS1	Carlos Ponce Sangines	H 1971	Tiwanaku, Espacio Tiempo y Cultura Academia NI. de Ciencias de Bolivia
NW	Nathan Wachtel	H 1971	Los Vendidos (La Conquista 1530-1570) Ed. Alianza Universidad, 1976
JVM	John V. Murra	H 1972	Un Reyno Aymara en 1567 Pumapunku, Inst. de Cultura Aymara,
EIG1	Dick Edgar Ibarra Grasso	H 1973	Prehistoria de Bolivia Ed. Los Amigos del Libro, La Paz, Bol.
MNP	Marina Nuñez del Prado	H 1973	Eternidad dn los Andes Ed. Lord Cochcrane, Santiago de Chile
CPS2	Carlos Ponce Sangines	H 1975	Origen del Dualismo Cultural en Bolivia Pumapunku/Inst. de Cultura Aymara
MBG	Mariano Baptista G.	H 1975	Tiwanaku Plata Publishing Ltda., Switzerland
AVV	Alipio Valencia Vega	H 1977	Julian Tupaj Katari Ed. Juventud, La Paz, Bolivia
HBR	Hugo Boero Rojo	H 1977	La Increible Ciudadela Prehispánica de Iskanwaya
UMSS1	Departamento de Arqueología	H 1977	Repartimiento de Tierras por el Inca Huayna Capac

CIP2	Josep Ma. Barnadas	H 1978	Apuntes para una Historia Aymara Cuadernos de Investigación Cipca/6
EIG2	Dick Edgar Ibarra Grasso	H 1978	La Verdadera Historia de los Incas Ed. "Los Amigos del Libro", La Paz, Bol.
AT	Alfredo Torero	H 1979	Lingüística e Historia en los Andes de Perú y Bolivia
CPS	Carlos Ponce Sangines	H 1979	La Cultura Nativa en Bolivia Ed. Los Amigos del Libro, La Paz, Bol.
ADV	Antonio Díaz Villamil	H 1980	Leyendas de mi Tierra Ed. Popular, La Paz, Bolivia
MEVS	María Eugenia Del Valle de Siles	H 1980	Testimonios del Cerco de la Paz (1781) Bil. Popular "Ultima Hora", LPB
KEY	NAME OF AUTHOR	MATER YEAR	TITLE OF DOCUMENT PUBLISHED IN
L		L	REFERENCIAS (LINGÜÍSTICA)
VVR	Víctor Varas Reyes	L 1960	El Castellano Popular en Tarija Talleres Gráficos Bolivianos, La Paz
JFCS	José Felipe Costas Arguedas	L 1961	Diccionario del Folklore Boliviano Univ M de San Francisco Xavier, Sucre B
EC&	E. Coumet y Coautores	L 1966	Lógica y Lingüística Ed. Nueva Visión, B. Aires
BM	Bertil Malmberg	L 1967	Los Nuevos Caminos de la Lingüística Ed. Siglo Veintiuno, México
VMA	Víctor Manuel Arroyo	L 1971	El Habla Popular en la Literatura Costarricense Ciudad Universitaria, S. José, C. Rica
VOA	Radio Voices of	L 1972	Special English Word Book United States Information Agency
HSF	Hernando Sanabria F.	L 1975	El Habla Popular de Santa Cruz Ed. Juventud, La Paz, Bolivia
NFN	Nicolás Fernández	L 1975	Diccionario de Bolivianismos Ed. Amigos del Libro, La Paz, Bolivia
ANPC	Antonio Paredes Candia	L 1976	Refranes, Frases y Expresiones Populares de Bolivia Ed. Isla, La Paz, Bolivia
APC4	Antonio Paredes Candia	L 1976	Refranes, Frases y Expresiones Populares de Bolivia Ed. Isla, La Paz, Bolivia
TT	T. Turner	L 1976	Die Satzkomplexität im Spanischen der Andenländer Linguistische Berichte V43, Wien
EDAF	Varios Autores	L 1977	Lecturas de Socio Lingüística Colección Edaf Univ., Madrid, España
APC	Alfonso Prudencio	L 1978	Diccionario del Cholo Ilustrado Ed. Ojo Publicaciones, La Paz, Bol.
VHV	Víctor Hugo Viscarra	L 1981	Coba: Lenguaje del Hampa Boliviano Ed. Popular/Isla, La Paz, Bolivia

KEY	NAME OF AUTHOR	MATER YEAR	TITLE OF DOCUMENT PUBLISHED IN
M		M	REFERENCIAS (LOGICA Y FILOSOFIA)
JFM1	José Ferrater Mora	M 1951	Diccionario de Filosofía Ed. Sudamericana, Buenos Aires, 1971
JFM2	José Ferrater Mora	M 1955	Lógica Matemática Fondo de Cultura Económica, México
HMC	Héctor M. Calderón	M 1966	La Ciencia Matemática de los Mayas Ed. Orion, México
B&M	I.M. Bochenski & Menne	M 1973	Grundriss der Logic UTB Schoeningh
AD1	Alfredo Deano	M 1975	Introducción a la Lógica Formal (Vols. 1 y 2) Ed. Alianza Universidad, madrid
JL1	Jan Lukasiewicz	M 1975	Estudios de Lógica y Filisofía Biblioteca de la Revista de Occidente
JL2	Jan Lukasiewicz	M 1977	La Silogística de Aristóteles Ed. Tecnos, Madrid
IGR3	Iván Guzmán de Rojas	M 1979	Niño Vs. Número Biblioteca Popular Boliviana, LPB
SH	Susan Haack	M 1980	Lógica Divergente (Deviant Logic) Colección Paraninfo, Madrid, España

KEY	NAME OF AUTHOR	MATER YEAR	TITLE OF DOCUMENT PUBLISHED IN
N		N	REFERENCIAS (NARRACIONES DEL MUNDO QOYA)
LADC	Lindauro A. de Campero	N 1894	Huallparrimachi Ed. Puerta del Sol, La Paz, Bol., 1975
AA1	Alcides Arguedas	N 1904	Wata Wara Ed. Puerta del Sol, La Paz, Bol. 1980
AA2	Alcides Arguedas	N 1919	Raza de Bronce Obras Completas, Ed. Aguilar, 1970
RBG	Raúl Bothelo Gosálvez	N 1941	Coca Ed. Los Amigos del Libro
CM1	Carlos Medinaceli	N 1947	La Chaskanawi Ed. Los Amigos del Libro, La Paz, Bol.
JLA2	Jesús Lara	N 1960	Leyendas Quechuas Ed. Librería Juventud, Argentina
FDM	Fernando Díez de Medina	N 1970	Ollanta el Jefe Kolla Ed. Los Amigos del Libro, 1970
APC3	Antonio Paredes Candia	N 1974	Antología de Tradiciones y Leyendas Bolivianas Ed. Los Amigos del Libro, La Paz, Bol.
NNT	Néstor Taboada Téran	N 1977	Manchay Puytu Ed. Sudamericana, B. Aires

APC2	Antonio	N	Cuentos Populares Bolivianos
	Paredes Candia	1978	Ed. Tupac Katari, Sucre, Bolivia
GF	Guillermo	N	Los Mitos Profundos de Bolivia
	Francovich	1980	Ed. Los Amigos del Libro, La Paz, Bol.

KEY	NAME OF AUTHOR	MATER	TITLE OF DOCUMENT
		YEAR	PUBLISHED IN
R		R	REFERENCIAS (GENERAL)
JC	Joan Corominas	R	Breve Diccionario Etimológico de la Lengua Castellana
		1961	Ed. Gredos, Madrid, España
GPLMT	Giacomo Prampolini	R	La Mitología en la Vida de los Pueblos
		1969	Vol. I y II, Montaner y Simón, Barcelona
TK	Thomas Kuhn	R	The Structure of Scientific Revolutions
		1969	Univ. of Chicago Press, Chicago, USA
JMR	Jorge Muñoz Reyes	R	Geografía de Bolivia
		1977	Academia NI. de Ciencias de Bolivia
INE	Indtituto NI. de Estadística de Bolivia	R	Resultados del Censo NI. de Población y Vivienda 1976
		1978	Ministerio de Planejamento y Coordin.
RS	Rafael Seco	R	Manual de Gramática Española
		1978	Ed. Aguilar, madrid, España



Iván Guzmán de Rojas *(picture april 2018)*

(March 30, 1934 - January 26, 2022)

As a boy, Ivan Guzman de Rojas would roam among the alpaca herds and mud huts of the high Andes with his father, at the time Bolivia's best-known painter of the Indians known as the Aymaras.

"My father would tell me, this is a rich culture," Mr. Guzman recalled of the Aymaras. "Don't be fooled just because its appearance is poor."

Now, 40 years later, Mr. Guzman says he has made discoveries that support his father's claim, although in an entirely unexpected way. He has concluded that the ancient Aymara language is an ideal tool for the computer.

Mr. Guzman, a German-educated mathematician, says that because of the unusual structure of the Aymara language, he has been able to convert it into an algebraic code. By using this code as an interface, or bridge, in the computer, he claims to have developed the beginnings of a multilanguage translation system. Several experts who have seen Mr. Guzman's work say he may be on the verge of a breakthrough in computer linguistics.

The Problem of Idioms

Computer translation, a field of research in which manufacturers have already invested millions of dollars, has always been hampered by the nature of human language, which is too whimsical and filled with ambiguities and hard-to-translate idioms to be handled easily by a machine.

But Mr. Guzman's formula, some experts say, deals with language in a mathematical way.

"Basically, I found a way to teach the computer any grammar by using the Aymara syntax," Mr. Guzman said.

In his home, along one of the capital's steep streets, the soft-spoken, 50-year-old scientist quickly turned passionate when referring to his research into Aymara, which he calls a "hobby that now dominates my life."

"The language is beautiful," Mr. Guzman said, holding the first known dictionary of Aymara, which was compiled by a Jesuit in the 16th century. "It is a very fine piece of logic, so compact and orderly, so well-conceived, you might think it was designed."

Aymara is related to Quechua - a language more widely spoken by Indians in South America - and is believed to be between three and five millennia old. Mr. Guzman said Aymara uses no irregular verbs or gender but builds ideas and sentences by adding strings of suffixes to root words.

Language of 2.5 Million Indians

Mr. Guzman said he began his work with Aymara largely in an effort to generate respect for the neglected culture and dying language of 2.5 million mostly illiterate Indians in the highlands of Bolivia and Peru.

Anthropologists and computer experts, he said, at first laughed at his claim that an ancient language was a fine mathematical tool. But as he developed his translation system and outsiders began to show interest, this has taken over most of his spare time.

He works on borrowed computers, usually on weekends or late at night. Although he founded and headed the Institute for Science Research at the University of La Paz, political in-fighting forced him to resign. Since then he has supported his five children by working as a consultant in accounting systems.

Several organizations in the United States, including Wang Computers of Lowell, Mass., have invited Mr. Guzman to the United States for demonstrations.

"Guzman's approach is extremely original," said Miguel Brazao, head of one of Wang's research and development divisions. "It is the only program that uses mathematics to go from one language to another. It is based on the algorithmic structure of Aymara. It is small and exceptionally fast and goes much further than the translation systems I'm familiar with."

Canada's International Development Research Center in Ottawa has published a 150-page monograph that Mr. Guzman wrote about his findings.

"Academically and professionally the analysis is sound," said Robert Valentin, a center official consulted by telephone. "We supported the work to look at the communication problems between Aymara and Spanish speakers, but we have no program to support machine translation."

Small Grant From Unesco

The United Nations Educational, Scientific and Cultural Organization has given Mr. Guzman a small grant to continue research.

Some scepticism was expressed by experts who had not seen the Aymara method but who said that systems using a bridge language have so far had only limited success.

Daniel Everett, a visiting scholar in the linguistics department at the Massachusetts Institute of Technology and an authority on Andean languages, noted that there had been many efforts to reduce one language to a mathematical form for translation into another tongue, but with only limited success.

A specialist at the International Business Machines Corporation also questioned the value of using an intermediate language, rather than direct translation. Aymara Lacks Modern Words

The discovery of Aymara's unusual properties happened accidentally in 1980, Mr. Guzman said, when he was searching for a new way to teach mathematics to Aymara children.

"I heard there were problems," he said. "We have always used foreign models in our educational system, often so alien that they become a joke." But he got into trouble, he said, because he could not figure out Aymara logic.

"So I made a truth table. Two-valued Boolean algebra did not work. I tried three-valued formulas, following the Polish scientist Jan Lukaciewicz. It worked. Then I got drawn in and studied the logical structure and the whole syntax on the computer. Once I had the algorithms formalized, I began translating."

Most of the work, he said, is still to come: the main drawback of Aymara is its lack of modern words, but its structure can easily incorporate modern ideas and vocabulary.

"That will also help the Aymaras communicate with the outside world," he said. "Right now the language is being corrupted by Spanish and eroding quickly."

After finishing the work on his translation system, Mr. Guzman hopes to get back to his plan to use the computer to translate textbooks into Aymara and to study the Indian thought process.

"I am now convinced that there is a different logic at work," he said. "This may be one reason why American Indian peoples have such trouble communicating with the European cultures around them."

"We need to study this," he added. "It's the key to our culture. If I can use the computer to do this and to protect the language, I'm satisfied. My dream is to get the Aymaras to read in their own language and to use my computer one day to start an Aymara newspaper."

