

# The Development of Pan-Nigerian Type for Typewriting and Printing

(technical report to the Federal Ministry of Education, Science and Technology for the National Language Centre, by Victor Manfredi 23 July 1985, in Lagos)

## 0. Introduction: the need for Pan-Nigerian type to be designed

Although typewriters and typesetting equipment have been adapted for various Nigerian languages over the years, the Pan-Nigerian typewriter project of the National Language Centre has addressed the need for a single, standard, efficient set of tools for writing all the major languages in those technologies which are presently used for text-production and reproduction in Nigeria, as well as those technologies which will eventually be introduced.

The manual, 46-key office typewriter is an ideal starting point for addressing this need, for a number of reasons. First, it is a proven technology universally available in Nigeria. Second, the costs of adapting it are modest, both in time and money. Third, it imposes a certain discipline on the general design due to the limited inventory of symbols which it can contain. Above all, and as a result of the foregoing, it provides a proving ground for testing, demonstrating and popularising the idea of a unified graphic system for all the nation's languages, such that the adoption of this design in the other desired technologies can be cheaper, faster and more effective.

It is on these grounds that I proposed, at the typewriter design meeting of consultants to the Language Centre (Benin City, 19 July 1983), that the problem of adapting the manual office typewriter should be addressed in the context of an overall design for Pan-Nigerian type. The typewriter itself, after all, is an adaptation of printing type to uniform spacing requirements after 500 years of evolution in movable-types. It will be seen below that the typewriter is in some ways easier, and in other ways harder, to adapt to the requirements of Pan-Nigerian; the danger in solving design problems piecemeal is that what looks ideal in isolation may be an unfortunate choice when the totality of uses is considered. The design we now have permits all applications to be maximally homogeneous and compatible.

The rest of this report follows this outline:

1. Design requirements and the completed design
2. Prototype manual typewriter
3. Electric (golf-ball) and electronic (daisy wheel) typewriters/word processors
4. Hand-set type for letterpress printing
5. Linotype for letterpress printing
6. Use of handset or Linotype for offset printing (lithography)
7. Photocomposition for offset printing (lithography)
8. Digital composition for photocomposition, laserprinting and computer database
9. Appendix of documents referred to in the report
10. Conclusion

It would be wrong to develop any one of these technologies without considering the others. All of them are presently in use within Nigeria, or will be shortly. Because we now have a unified design, we have made significant progress toward the application of Pan-Nigerian type to all of them in the course of developing the prototype manual typewriter.

## 1. Design requirements and the completed design

The Benin meeting referred to above was a unique combination of representatives from government, linguistics and printing/publishing fields. Without such a combination, no design could have been achieved with any practical value. Linguists have been adapting their personal typewriters for the particular languages of their interest for many years, with uneven results. Many such "educated" typewriters exist in Nigeria, primarily in the numerous departments of linguistics/Nigerian languages, and a wide range of publications have been produced on them, either by stencil or camera-ready offset. Some of these publications, such as the Ibadan Research Notes or African Studies Occasional Publications, have maintained acceptable standards of legibility albeit at relatively great cost of labour time. This is where the contributions of the printers/publishers were most valuable: how to streamline the work of the typist/typesetter at the keyboard. It was discovered that an acceptably efficient keyboard had to depart from the model which the linguists prefer for their own work by eliminating some symbols that they find convenient but which are not strictly necessary in Nigerian orthographies, and by creating some unitary characters with their own "subdots" (specifically  $\text{e} \text{ } \dot{\text{e}} \text{ } \text{o} \text{ } \dot{\text{o}} \text{ } \text{u} \text{ } \dot{\text{u}}$ ) which the linguists find unnecessary since they are content to produce these characters by two keystrokes (the first stroke being the subdot alone on a "dead" key (.) and the second stroke being the desired letter).

After this discovery, breaking the efficiency deadlock, the meeting was convinced that a unitary Pan-Nigerian keyboard was possible. Some small compromises were still required from the linguists in their capacity as representatives of various Nigerian languages, to harmonise certain minor writing practices. Such compromises were made by Hausa, Igbo, Izon and Yoruba as follows:

Hausa: glottal stop to be written with inverted comma at  $\frac{1}{2}$  space as in 'ya 'daughter'  
Igbo (and Efik-Ibibio): velar nasal to be written with macron as in  $\text{onwu}$  'drinking'  
Izon: "rising" accent ( $\vee$ ) to be done by hand or with combination of  $\text{low} + \text{high}$   
Yoruba: "subdot" to be separated from body of letter, thus  $\text{e} \text{ } \dot{\text{e}} \text{ } \text{o} \text{ } \dot{\text{o}} \text{ } \text{u} \text{ } \dot{\text{u}}$  not  $\text{e} \text{ } \dot{\text{e}} \text{ } \text{o} \text{ } \dot{\text{o}} \text{ } \text{u} \text{ } \dot{\text{u}}$   
on condition that it be a vertical stroke, not a simple dot (thus  $\text{e}$  not  $\text{e}$ ).

These points, which are of mere historical interest in themselves, are mentioned here to illustrate the kind of compromise which was required at the Benin meeting, in order to "keep the keyboard one". They do not represent changes in the orthographies of the individual languages concerned, but they do represent changes in the graphic interpretation of those orthographies which make it possible for the Federal Government to have a unitary design which can be the basis of investment (public and private). Individual publishers, states or language groups do not have the resources to develop different orthographies into tools of mass production; only the Federal Government can organise a design that is economically feasible because of its general usefulness and streamlining.

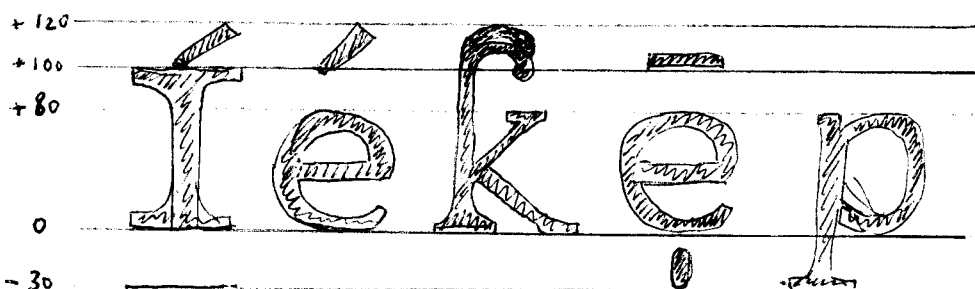
This is not to say that Nigerian orthographies are, or should be, totally consistent with each other. For historical reasons, southern Nigerian languages have gradually opted for the "subdot system" which was first introduced by S. Ajayi Crowther in 1875 for Yoruba. Subdots have gradually replaced "special symbols" in Igbo (1961), Edo (1974-5), Idoma and Efik-Ibibio, for the representation of narrow-pharynx vowels. Other African countries, e.g. Ghana, have retained special symbols for these vowels, and if the Nigerian system is better we have Bishop Crowther to thank. Orthographic harmonisation for the whole African continent seems clearly unattainable, but the effective harmonisation of Nigerian orthographies which the Pan-Nigerian design accomplishes is, I believe, a historical achievement. It happens that most northern Nigerian languages (Hausa, Fulfulde, Kanuri etc.) employ some special symbols, notably "hooked"  $\delta$   $\delta'$   $\delta''$  as well as the "schwa"  $\epsilon$ . It is a singular coincidence that there is no acceptable way to type the "schwa" with a subdot, so the special symbol seems inevitable; as for the hooked letters, they would be less felicitously written with subdots since too many subdots with different meanings would definitely be confusing, ungainly and illegible. In the case of the northern orthographies, therefore, we can say that consistency with the southern orthographies in all details would have been impossible on linguistic grounds, and that the four special symbols required for the northern Nigerian languages are complementary with the southern diacritics ("subdots").

The subdot poses a number of technical problems which are in effect solved by the compromise on its shape between the Yoruba and Igbo norms. For one thing, a pure dot is easily obscured by underlining (on a typewriter), and drops out rather easily in both direct and photographic/xerographic systems of reproduction since it is not heavy enough. For another, a connected line does not harmonise with the letters  $\underline{i}$  and  $\underline{u}$  on purely graphic grounds. Some white space between the letter and the subdot is optimal for legibility. Unfortunately, however, the Roman alphabet did not evolve with much importance given to letterforms descending below the line of writing (it began as an all-capital alphabet with the greatest density of visual information along the top third of the writing line, which became the height of the lower case letters that developed out of Uncial script in the late middle ages). Making the subdot vertical in dimension helps its legibility and reproducibility, but there is a very narrow limit below the line for that dimension to extend. It became clear at the Benin meeting, therefore, that some advice would be needed by any type caster on how much room there was for the subdot to extend downwards.

A similar problem is associated with the tone marks that come above the ten different vowels as well as the nasals  $\underline{m}$  and  $\underline{n}$ : it should be at the same height for both upper and lower case letters (otherwise two extra keys would be needed on the typewriter), yet there is no "room" above the upper case letters due to the limitations of the height of type bars (both in typesetting and typewriting, but especially in the latter where the platen under the paper is curved away from the type as the letter ascends higher, thus:



This consideration also applies to the subdot but is much more serious with the tone marks since they are read differently depending on their angles/shapes whereas the subdot is a binary mark which is either present or absent. It appeared that the only way to make the tone marks ("accents") work in combination with upper case letters was not to raise the accents but to lower the letters. Once again, this solution does not appear very strange when the history of alphabetic writing is considered. The classic ratio of lower to upper case before the 19th century was much closer than today, perhaps 8:10 versus 6:10. Since typewriter type is already produced in two sizes, pica (larger) and elite (smaller), what Pan-Nigerian needs is essentially pica lower case and elite upper case; then the tone marks can be positioned as low as possible so that they just graze the tops of the upper case letters, and they will not be too high for the lower case letters, thus:



é, è, ê

With these design specifications (Appendix 9.1a,b), Pan-Nigerian became a theoretical possibility; the typing specialists at the meeting helped determine optimal key placement (9.1c), and the meeting proposed a timetable for delivery of a prototype typewriter, as well as typesetting matrices for both lino- and photo-composition (9.1b section 4.0). My proposal to the meeting was adopted as a recommendation, namely that a qualified type designer be contacted to complete what we had started. I proposed Prof. Hermann Zapf, who is universally acknowledged to be the leading type designer in the world, someone who has worked both with classic European typefaces and also with the application of advanced technology to new typefaces in languages such as Arabic, Russian and Greek. The Language Centre asked me to locate him (Appendix 9.1d), which I did by September 1983 when I had a short visit to the U.S. Zapf was visiting Prof. at Rochester Institute of Technology in 1983, a fact which I did not know, so that my letter had to be forwarded to him from Darmstadt, West Germany.

From the outset, Zapf worked with great speed and without asking for payment. I must put it on record that he has expressed a philanthropic interest in the project, which I can paraphrase as follows: "Nigeria has given so much to the world with its great bronzes of Igbo Ukwu, Ife and Benin; it is only fitting that Europe should do something for Nigeria." I received his initial sketches at Nsukka; these were, however, off the mark in several crucial respects. I replied with corrections via Prof. Armstrong, who traveled to Darmstadt in December 1983. Meanwhile, Zapf asked the Neufville type foundry in Barcelona to make some trial engravings of his drawings to test the feasibility of our desired proportions. Zapf has worked, since 1947, as artistic director of D. Stempel type foundry in Frankfurt, but Stempel has been on the verge of closing for the past few years; Neufville on the other hand is gradually absorbing all the other type foundries in Western Europe. By the time the Neufville proofs were ready, I was back at Harvard; I observed that the original design problems had not been corrected, and this information found its way to Zapf through Neufville (for some reason Zapf did not receive his copy). It was in this way that Zapf prepared his final drawings in preparation for the Ministry delegation in July 1985. The revised versions of these drawings, based on our face-to-face work, are attached as Appendix 9.2a,b.

A number of issues need clarification with respect to these drawings. 9.2a is the typewriter face, drawn at scale. This is useful as a guide to the production of machines but is inadequate for the moulding of the type bars since this requires large-scale drawings as found in 9.2b. But the large scale drawings of 9.2b are not done in uniform spacing such as is required on all typewriters except for the IBM Composer. I had believed that typewriter type bars are cast in the same way as foundry type, but I learned in Barcelona that the processes are different: typewriter bars are pressure moulded from steel alloy while foundry type is liquid-cast from a lead alloy. So the way that the typewriter face is produced requires the two drawings to be read together, such that 9.2b provides a guide to details in which 9.2a departs from standard typewriter type. But 9.2b does not reflect the reduced upper-case proportions which are necessary in any application, so it must be read in conjunction with 9.2a for correct proportions.

Secondly, since the accents (tone marks) are not separate from the letters in 9.2b, the impression is given of a small number of total symbols (64 excluding ä, å, numerals etc). Actually, of course, the tone marks freely combine with all the vowels (10 upper case and 10 lower case) as well as the nasals (m and n). The total number of unitary symbols with tonemarks included is actually 166 alphabetic symbols, and with the addition of numerals, punctuation etc. the total comes to 195 (or 196 including ä) - see Appendix 9.3a.

A third caveat about the design is that Zapf chose to use an existing Roman type to construct the new characters around. The Benin meeting specified a bold, serif type style (9.1a 3.0.3). Serif type is another word for Roman, as opposed to sans-serif (or Grotesk) type. Of course he could have started an entirely new Roman type, but the time and expense associated with such a job would have prevented us from continuing for several years. The basis of the Pan-Nigerian drawings in 9.2b is a typeface called Impressum, which was designed in the late 1950's by Walter Baum as a condensed form of his earlier Volta design, both done at the Bauer type foundry in Frankfurt. All the Bauer types were bought by Neufville when it acquired the foundry in 1972. Neufville therefore "owns" Impressum; it obviously does not own the changes in Impressum which Zapf made to accommodate Pan-Nigerian. Zapf has transferred all his rights in Pan-Nigerian to the Federal Ministry of Education (9.2c). The question is how to register the Ministry's rights on Pan-Nigerian.

Zapf proposes that the Ministry contact the World Industrial Patent Office (WIPO) in Geneva and inquire about the possibilities of protection. The director of Neufville, Mr. W.A. Hartmann, doubts that the modifications on standard type in 9.2b are sufficient to permit a separate patent. It is my impression that Zapf would disagree, since his signature on 9.2b implies that it is an original artwork (even though it uses some existing type as its basis). Zapf also advised us that piracy of type designs is the norm (many of his own designs, especially Optima and Palatine, have been pirated around the world. Unfortunately, the Pan-Nigerian drawing in 9.2b does not have the correct upper-case proportions (which are unique to our design and probably patentable). I recommend that the Ministry contact WIPO for advice, and meanwhile secure an agreement with Neufville and Olivetti regarding the rights to production of Impressum-based Pan-Nigerian foundry type and Pan-Nigerian typewrit-

ers. Part of any such agreements should be the rights to use the final designs, which can be identified with proofs of the printed letters (letterpress proofs of the Neufville type and typed proofs of the Olivetti type). The Ministry should be able to transfer the typewriter rights to any other manufacturer, since Olivetti did not supply any of the design inputs; as for the use of Impressum, with its Pan-Nigerian modification, the problem will not arise with Linotype since Impressum is already licensed to at least one major Linotype matrix manufacturer (Matrotype in Milan, Italy). The problem of joint Neufville and Nigerian rights in Impressum-Pan-Nigerian will only arise in the application of the design to photocomposition and digital typesetting. I recommend that the Ministry keep discussing the matter with Hartmann, Zapf and WIPO. The best arrangement will be one that secures some Ministry leverage over the manufacturers of the various type technologies since design-piracy has made the commercial value of type designs less absolute these days. In metal type, one may possess the engraved matrices; but in phototype, once any text is printed it can be copied with a mere snap of the camera shutter, and slightly altered so as to avoid a provable offense. The Ministry should therefore, I feel, pursue a pragmatic course aimed at rapid commercialization with maximum leverage. More will be said on this subject in connection with the individual type technologies discussed below. Zapf has put the Ministry's ownership of Pan-Nigerian in his recent book (Arbeitsbericht: 9.2d-e). In summary, I feel that the Pan-Nigerian design 9.2a-b is complete insofar as it can serve as the basis of all applications such that these applications fully satisfy the specifications of the Benin meeting. I am quite happy about the quality of the design. And although a full set of typewriter and letterpress proofs are desirable for ultimate documentation of the design especially as far as copyright issues are concerned, I do not believe that the legal issues surrounding the design need to delay the development of working prototypes of all the applications which the Ministry may desire. Given this state of affairs, the significance of Zapf's letter releasing the rights over the design to the Ministry is a matter for legal consultation; the letter is reproduced as 9.2c.

## 2. Prototype manual typewriter

When I learned that Neufville was unable to cast manual typewriter type, I was directed by Neufville to Olivetti which has its world headquarters for manual typewriter production in Barcelona. It should be mentioned that Neufville's type catalog does list several "Maschineschriften", but it turned out that these are foundry types made to imitate the appearance of typewritten copy. I regret the confusion on my part. Fortunately, the chief engineer and production manager of Hispano Olivetti, Jose Llanos, lost no time in understanding our needs with the aid of Zapf's drawings. He sold us an office machine for which he will produce the special type bars by the end of September; these will be sent to the Ministry for fitting into the machine, at which point a demonstration can take place with texts from the nine major languages. I would appreciate being sent a copy of these texts (to my Harvard address) so that I can assess how well Llanos copied the design. I may be able to come to Nigeria in December 1985, but only if this is necessary. Before I leave Lagos I will discuss the job of fitting the new type bars onto the machine with Mrs. Marinho's designated technician; the best thing will be to go through the steps of removing and replating one of the bars from its pivot, so as to anticipate any problems.

At that stage, when the proofs of the typewriter face are approved, the Ministry will be able to negotiate with all interested typewriter manufacturers for the rights to produce the Pan-Nigerian manual typewriter. Because the standard office manual machine has only 46 keys, the machine cannot contain the keys for X and Q, which are needed for English. I would strongly recommend that the Ministry also try to find out if there is a manufacturer of 48-key office manuals, since such a machine could then type English as well as all the major Nigerian languages: this would give it an unapproachable market position and enable the Ministry to extract the best terms from the manufacturer, since the demand for English typewriters is already very high, and since many of the applications of the typewriter will be in situations of bilingual texts between English and one or more Nigerian languages. Most electric typewriters have 48 keys, so this aspect should be explored at the same time (see section 3 below). As far as Olivetti is concerned, I can only communicate my strong impression that they are interested in supplying for the Nigerian market and that they are quite capable of producing with adequate quality, speed and economy. Mrs. Marinho has the relevant documents from Llanos/Olivetti.

## 3. Electric (golf-ball) and electronic (daisy wheel) typewriters/word processors

It is part of the history of the Pan-Nigerian project that the IEM company was at one time in communication with the Ibadan Dept. of Linguistics & Nigerian Languages about producing a "golf-ball" type element for Nigerian languages. The golf-ball fits the Selectric I, II, III models of typewriters; models II and III have the self-correcting lift-off tape feature. The Language Centre's Selectric typed the second Orthography manual and is being used to type the third, for direct offset printing without further typesetting. Many international journals of linguistics are typed camera-ready on Selectrics because of the flexibility of the inter-changeable golf-balls, as well as because the ribbon quality is so high. But IEM has not been putting much research and development into the Selectric line of electric typewriters in recent years, since the advent of microchip processor-based electronic typewriters which use daisy wheels, and are connectable to word processors with modest display and memory functions. In fact, the Selectric was originally linked to an early word processor (called MTST), but the golf ball is not fast enough for

present-day word-processing standards. It happens, however, that many people still prefer the Selectric for camera-ready applications, since speed is less important than flexibility and reliability, and especially print quality.

It is therefore desirable that the Ministry consider commissioning a Pan-Nigerian golf-ball (and also possibly a daisy wheel). Since both technologies have 96 symbols, i.e. 48 symbols multiplied by 2 for upper and lower case positions, they could easily be Pan-Nigerian plus x and g for English. Most scientific publishing in Nigerian languages, and all popular publishing with a projected quantity of less than 20,000 copies, could be most efficiently and legibly done with a Pan-Nigerian golf ball plus offset printing. The problem is that IBM does not invest in the golf-ball any longer, and all new golf-ball designs are produced by the Honolulu, Hawaii firm Camwil. I have obtained Camwil's price for a new casting of a golf-ball, which is attached as Appendix 9.4a-b. The Ministry should, I believe, contact Camwil for exclusive rights to Pan-Nigerian golf-balls and daisy wheels, since the market for these is potentially great (especially as many Nigerians are now purchasing electronic typewriters and word processors). But even if these rights prove to be too expensive, or are unenforceable because of piracy, I strongly urge the Ministry to commission the production of these elements in the interest of faster and cheaper reproduction of Nigerian language texts by government and private publishers. The golf-balls can even be used to cut roneo-type stencils, with results superior to those produced by ordinary typewriters, so the golf-balls would be useful for small-scale, local production of materials in universities and colleges that could own a Selectric (every Nigerian university owns several Selectrics at least).

#### 4. Hand-set type for letter press printing

I have already described how Zapf introduced us to Hartmann's Neufville foundry, perhaps the last functioning hand-type foundry in Western Europe. Hand type is dying out in the highly industrialized countries, due to the availability of phototypesetting as from the 1970's. But in South America, India and Africa, hand type remains the mainstay of the commercial printing industry. Most local printers in Nigeria employ hand type. There are two size-systems of hand-type: Didot (French) and Pica (English). Hand type is cast in a lead alloy and is somewhat fragile, having a lifespan of only a decade before it begins to break up. Needless to say, one of the problems with local printing in Nigeria is the fact that the hand type being used is very old and in need of replacement.

Hartmann's Neufville is 100 years old this year, and holds a virtual monopoly on the casting of hand type since it bought out the matrices of most of the other European foundries; it is negotiating to buy the last major foundry this year. It is located in Spain because of lower labour costs, although its technical and financial direction is West German. After consultation with the production manager, W. Heinz, I determined that 110 existing matrices of Impressum could be carried over into Pan-Nigerian without any change, but that 85 new matrices would be needed to complete the face. The list of both categories is given in Appendix 9.3a. We ran a test proof of the existing characters in a special height ratio to determine if the tonemarks could be kept level, and we found that the five most common sizes of type could be cast on Pica with proper heights (the 24 point size has slightly uneven heights but this is the biggest size usually only used in titles where the difference can be accepted). Prof. Zapf has approved of this proof (which is given as Appendix 9.3b). Hartmann has communicated to Mrs. Marinho the cost for him to engrave the remaining 85 matrices, and he has offered the Ministry two alternatives: pay for the new matrices and thereby own them, or allow Hartmann to pay part or all of the cost of the new matrices (about 31,167 US dollars) in exchange for his getting the exclusive right to produce Pan-Nigerian hand type and import it into Nigeria. I would advise the Ministry that, given the lack of competitors to Hartmann, there is little lost by granting him exclusive rights; this would save the Ministry the capital cost of the Matrices.

The Ministry can easily verify the impact on Nigerian printing and publishing of a ready supply of hand type for Nigerian languages (and English, with the addition of x and g). The local printing industry would be able to offer low cost, high quality service on its own letterpress machines, without any imported technology whatsoever. Most local printers now turn down jobs in Nigerian languages because they do not have the necessary type. I therefore strongly recommend that the Ministry should conclude an arrangement with Hartmann as soon as possible. Zapf will provide Hartmann with the necessary large-scale drawings (without cost, I believe), and production will take about 6 months. As noted in the section on design, the full set of proofs from letterpress type is the surest way to establish the complete Pan-Nigerian design at actual scale, so as to guarantee that the quality of subsequent applications will be of an equal standard (letterpress is known as the highest quality standard in printing). Hartmann seems to want to be flexible about the fact that he already owns Impressum, since his chief desire is to diversify his market into areas of the world that are going to depend on the old letterpress technology for years to come. The engraving of matrices at Neufville will also lead directly to the production of linotype matrices (primarily for newspapers and journals), as described in the next section. Finally, as described in section 6 below, both kinds of letterpress type (hand type and linotype) are usable for offset printing via single proof method, a kind of hybrid technology that has certain appeal to developing countries where offset is important but where phototypesetting equipment is difficult to maintain.



## 5. Linotype for letterpress printing

Because of the arduous labour involved in setting hand type, especially in daily newspaper production, various technologies of automated typesetting for lead alloy type were developed in the last century. Monotype, the oldest, sets individual characters as they are selected by a keyboard; intertype and linotype set entire lines of type at a time. Many linotype machines are in use in Nigeria; Caxton Press uses monotype. Monotype developed some Nigerian language characters in the 1950's: the Ibadan/Cambridge University Press series of grammars including those by Profs. Bamgboye and Williamson are set in Monotype. The word linotype is often used as a generic term for all automated typesetting systems which use lead casting. Unlike foundry type, which is cast at the factory and shipped to the printer who selects the appropriate letters and combines them in forms, linotype is a system whereby the printer owns the matrices themselves, and casts the letters "to order". The quality of linotype is somewhat lower than hand type, only because the automated process of casting and setting in lines is subject to wider tolerances than those of hand labour; but the enormous time saved in machine-setting can be used, in part, for quality checking and correction so that bad sets can be removed and replaced.

As mentioned, the Neufville face Impressum is already part of a Linotype system, as produced by the company Matrotype in Milano, Italy. Hartmann promised to give us the address of Matrotype, but we failed to remind him. In any case, I think there is no harm in contacting Matrotype and asking them to quote on engraving the extra matrices (85) to complete their Impressum for Pan-Nigerian. Other Linotype companies could also be asked, although Hartmann informed us that Matrotype is more aggressively interested in expanding their market than are their British competitors. The development of Pan-Nigerian linotype will be a boon to the Nigerian-language newspaper industry. If the price of newsprint (paper) declines, it may become economical to print schoolbooks on newsprint instead of opaque text paper; they should be priced competitively with newspapers. It has also been suggested that newspapers should publish educational supplements, and this would be possible in Nigerian languages if Pan-Nigerian matrices for linotype were available. I do not know the working lifespan of a linotype matrix, but it is possible that the matrices now in use in Nigeria are in need of replacement; if so it would be better for the new matrices to be multilingual in Pan-Nigerian and English (with g and q). A vital issue which must be investigated is the size of the matrix magazine in the kinds of linotype machines in use in Nigeria, since they must be capable of holding up to 195 (or 196 with g) individual matrices in order to be able to set Pan-Nigerian efficiently. I will try and find out what the normal capacities are, to see if we are in the realm of possibility. It is my impression that Monotype has a larger magazine than Linotype, in which case the Monotype company should be contacted instead, or in addition.

As far as the commercial arrangements, the Ministry should consider offering the incentive of import assistance in exchange for the necessary investment in extra engravings. If this is impossible, then as an alternative it is going to be necessary to finance the development directly. I believe that the matrix manufacturers will, as Neufville does in the case of foundry type, much prefer to spare the Ministry the expense of direct payment if they can be confident of access to the Nigerian market, which still uses letterpress for economic production.

## 6. Use of handset or Linotype for offset printing (lithography)

Offset printing utilizes a photographic image which is negative, then transferred to a positive, ink-attracting coating on a plate. The plate, when inked, transfers the positive image in reverse to a rubber blanket ("offsetting" it). The blanket then reverses the image a second time onto the paper, so that it reads in the correct direction. Offset printing is especially good for reproducing photographic images such as newspaper photos; it also can reproduce type that is photographically produced. Phototypesetting is far faster and more flexible than letterpress typesetting (either hand or linotype). But nothing prevents the camera from taking a picture of type that has been produced by letterpress. This option has been employed extensively in India, where both letterpress and offset presses exist but where (as in Nigeria) the lack of parts and maintenance as well as the climate make it difficult to keep phototypesetting equipment (e.g. Compugraphic) working well. The printer sets the desired text with letterpress type, takes one proof, touches up the proof and lays it out in any desired way, adds positive photos etc. then photographs the whole. This negative is then burned onto the offset plate in the normal way and the rest of the process is normal. Such an expedient is used by some presses in Nigeria (e.g. Assumpta Press in Owerri). This implies that the development of Pan-Nigerian letterpress type could simultaneously serve the offset industry in Nigeria.

## 7. Photocomposition for offset printing (lithography)

Photocomposition (phototypesetting) is a process whereby photographic paper is exposed with the letter images and then developed like any black-and-white photo. In more advanced forms, the negative is produced directly, but as practiced in Nigeria the positive image is rephotographed and the resulting negative burned onto the plate as described in the previous section. Compugraphic machines are in widespread use in the bigger printing houses in Nigeria, despite the problems of repair. Typefaces for photocomposition are themselves contained on film, in all the different styles and fonts. The phototypesetter does not see

the type itself while entering the text at the keyboard; rather, the typesetter sees the coded alphabetic representation of the type on the cathode-ray screen (similar to a TV). This is a drawback when the typesetter is not skilled in visualising the finished type during the entry process. Among the biggest problems with phototype is the spacing of tables and other tabular material such as indentations; only a very skilled operator can produce acceptable copy on the first try. Usually, the material has to be set several times at the cost of time and materials. Applications of Pan-Nigerian to phototype will be primarily by large publishers who can employ highly trained staff and afford to maintain the equipment. Secondly, advertising and display copy in Nigerian languages will be phototypeset, by and large.

Due to the nature of the technology and its relatively upper-level applications, I do not see any need for the Ministry to invest in Pan-Nigerian photosetting. Rather, once the basic letterpress face is established (with the help of proofs and subject to the design issues raised at the outset of this report), the Ministry should invite the major photosetting companies to pay lump sum royalties for the right to produce and sell Pan-Nigerian linofilm/phot setting faces, in the fullest possible range of fonts (i.e. medium, bold, italic, shadowed etc.). The ease with which photofaces can be pirated should caution us that once the face is in public circulation, it will be copied; at the outset, however, phototypesetting companies should be willing to purchase the design along with the imprimatur of the ministry.

One possibility which deserves consideration is to discuss, with the phototype companies, their investing in more advanced type technology (e.g. digital) as the equivalent of their paying for the design. I believe that the exchange would be to the advantage of the Ministry, since it is the data processing applications that promise to have greater impact in Nigeria over the long term. These are discussed in the final substantive section.

#### 8. Digital composition for photocomposition, laserprinting and computer database

The advantages of digital data processing are increasing almost daily, as more and more applications become possible. In the field of Nigerian language development, the single most important application is, in my opinion as a linguist, the development of lexical database for individual languages as well as multilingually, for the production of large-scale dictionaries. At the moment, all the data has to be hand-processed because no machine can store a character with diacritical marks, e.g. the morphemes *kò, kó, kǎ, kɛ, kɛ́, kɛ̀* are all stored in the same way. One can devise complex codes for entering these six morphemes, in effect a secondary diacritic system on top of the primary one, but the possibility exists for the Pan-Nigerian keyboard to be programmed onto the 48 keys of the microcomputer via the ascii code that links the keys to the processor. A person who typed Nigerian languages at 40 words per minute could then enter language data at roughly the same rate. The other development that would be necessary to get something out of the processor is the adaptation of the output language to the Pan-Nigerian design. The output language instructs the printer/typesetting machine on the shapes of the characters in a digital code, describing all the geometric lines which are tangential to the form's outline.

At the moment, the most flexible keyboard is the Macintosh, with its Macpaint pasteup and design software. I have inquired about the feasibility of putting the Pan-Nigerian keyboard on the Macintosh, and it appears to be relatively simple. The Macintosh output language is Postscript, which is understood by Mergenthaler phototypesetting equipment and also by the Adobe laserprinter which is marketed by Apple as the Laserwriter. Appendix 9.5a-b describes the Macintosh-Laserwriter combination. I have forwarded to the language Centre a proposal by a Macintosh programmer, Edward Ugwuejiofor, to adapt both input (ascii) and output (Postscript) to Pan-Nigerian. This will permit a Nigerian-Language database to be processed and printed in camera-ready form, as is required to produce the Quadrilingual Legislative Terminology Glossary.

The Laserwriter currently prints in 300 dots per inch, whereas photosetting is at effectively 6000 per inch. Professor Wapf feels that once laserprinting is improved to 600 dots per inch (a simple binary split of each dot in each dimension), its quality will be substitutable for photosetting in all but the smallest sizes (e.g. 6 point pica). The laserprinter produces copy on plain paper, without photographic chemicals. Both the Macintosh and the Laserwriter are portable, and what is more they are separable, so that the data entry and processing could be done on a Macintosh in Nigeria, while the typesetting could be done on a Mergenthaler digital image processor or an Adobe Laserwriter in another country, from the floppy disc. This hard copy would be photographed and printed by offset in the normal way, or plated directly from the floppy disc in a suitably equipped printing plant.

Although nobody would seriously propose that most Nigerian language typesetting be done in this way, I am arguing that there is no other way to do the kind of complex data processing and typesetting (e.g. realphabetisation, context searching) which modern lexicography demands. The Ministry would be well advised to explore this option if it can arrange for external subsidy of the programming, as from these companies themselves or from the traditional foundation grants.

9. Appendix of Documents10. Conclusion

The applications of Pan-Nigerian type are only crudely sketched in this report. The technical issues are all better addressed by those with intimate experience in the individual technologies. The questions of incentives and/or direct government investment in these technologies are certainly beyond the scope of this report, except insofar as I have been able to indicate the relative ease of each application and its potential on the Nigerian publishing scene. My main effort has been to see that the requirements of Nigerian language orthographies, as reviewed by Prof. Williamson and the Panin meeting, are adequately served by the Pan-Nigerian face, especially within the tight limits of typewriter technology but certainly more generally in other, finer forms of type.

Through the good offices of Prof. Zapf, and Herr Martmann, we have been offered the chance to participate in the Fete de la Lettre holding in the French Cultural Centre in Lagos in November 1985 and then in other African cities. I propose that the Language Centre exhibit Pan-Nigerian at the Fete by having good literary texts in the nine major languages set in the typewriter and typesetting faces, blown up to poster size. The typewritten texts can be longer than the typeset ones, since the typewriting can be done on the prototype typewriter when it is completed; the typeset texts will have to be done by Zapf by hand, so they should not be more than one or two short sentences. The response to the design at the Fete should provide an index of what we are accomplishing.

I thank the Ministry and the Language Centre for the opportunity to contribute to this project. I will call on Mr Adegoye's office on 13 August to answer any questions on this report and to collect the replicas requested by Zapf for delivery to him in Frankfurt along with any other messages. Thereafter I can be reached back at Harvard.



Victor Manfredi



FEDERAL MINISTRY OF EDUCATION,  
NATIONAL LANGUAGE CENTRE,  
6, OBANTA ROAD, APAPA.

SECEDUCATE

FME/LC/88/1/117

4th August, 1983.

Mr. Victor Manfredi,  
.....  
Dept. of Linguistics,  
.....  
...University of Nigeria.....  
...Nsukka.....

Dear Sir,

Typewriter Design

I am directed to forward to you the minutes of the Typewriter Design which was held in Benin on 19th - 20th July, 1983.

I am further to convey to you the Centre's appreciation for the time you took off from your busy schedules to attend the meeting and for your immense contribution.

Thanks for showing interest in our work. We hope to hear from you again.

Yours truly,

*SRG*  
E.R. Ejenavi (Mrs)  
for: Permanent Secretary.

L/U/I

Appendix 1b

MEETING TO DISCUSS TYPEWRITER DESIGN FOR NIGERIAN LANGUAGES HELD AT  
MOTEL BENIN PLAZA ON 19TH JULY, 1983.

1.0. Attendance

Professor Kay Williamson (Chairman) University of Port-Harcourt

- |                       |   |  |
|-----------------------|---|--|
| Dr. A.U. Iwara        | - | Institute of African Studies, University of Ibadan.          |
| Dr. P.A. Nwachukwu    | - | Dept. of Linguistics, University of Nigeria Nsukka.          |
| ✓ Mr. Victor Manfredi | - | Dept. of Linguistics, University of Nigeria Nsukka.          |
| Dr. B. Ikara          | - | Director, Kaduna State Council for Arts and Culture, Kaduna. |
| Mr. M.A. Adeyemi      | - | Academy Press, Lagos   |
| Mr. J.A. Akinbohun    | - | The Chief Editor, National Assembly, Lagos                   |
| Mr. D. Ogunmiluyi     | - | National Assembly, Lagos                                     |
| Mr. A.O. Adu          | - | Language Centre(FME), Lagos                                  |
| Mrs. E.R. Ejenavi     | - | Language Centre(FME), Lagos (Secretary)                      |

2.0. Opening

The meeting started at 11.45 a.m. There was self introduction by participants and the committee embarked on the business of the meeting. The National Assembly staff at the meeting criticised the sample typeface presented on the grounds that it would not meet their needs because it would slow down the speed of the typist thereby hamper the business of the Assembly. The Assembly staff suggested <sup>separate</sup> ~~different~~ keyboards for each of the three main Nigerian languages. There was wide ranging discussion over the various proposed keyboards to handle the 3 major Nigerian languages distinctly at professional levels of speed and accuracy. A main preoccupation was to reconcile the needs (speed and accuracy) of the National Assembly with the proposed single keyboards for Nigerian languages as originally designed. It was found possible to do so by making subdots integral to the vowel symbols thereby reducing the number of dead keys and extra typing strokes. Placement on the keyboard was equally governed by the needs of the typists and the minimum of changes in typewriter key positions from the standard. The typographical design of individual symbols was discussed with a view to maximum legibility and compactibility of all the symbols together.

- 3.0. (1) Taking all factors into account the most convenient keyboard is as attached.
- (2) Pica type should be used.

# PROPOSED KEYBOARD FOR NIGERIAN LANGUAGES

DEAD



2

3

4

5

6

7

8

9

10

11

12

DEAD



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46

Non-Roman symbols

Key 36 ə ɜ (schwa) e.g. Kanuri

Key 12 k K (hooked k) e.g. Hausa

Key 38 ɓ ɓ (hooked b) e.g. Hausa, Fulfulde

~~Key 11 ɗ ɗ (hooked d) e.g. Hausa, Fulfulde~~

~~Key 11 ɗ ɗ (hooked d) e.g. Hausa, Fulfulde~~

Tone Diacritics on dead keys, i.e. diacritic must be typed before letter

Key 13 ` (grave) for low tone

Key 25 . (dot) for high tone

Key 36 ˇ (vertical sub-dot) for Yoruba

Key 41 ^ (acute) for high tone

~~Key 11 ˆ (circumflex) for rising tone~~

- (macron) for downstep or mid tone

~~Key 11 ˜ (tilde) e.g. Efik or Igbo ñ~~

^ (circumflex) for falling tone

Subdots on keys 23, 24, 34, 35, 46: short, rounded vertical bar some space below letter.

U.C.: no more than 150% of L.C. size

tone diacritics: tapered, top weighted bold, shallow angle, grazing the tops of capital vowels underline: between vowel and subdot inverted comma: vertical tapered top-weighted

*[Signature]*  
V.B. MANFREDO  
20/2/83

# FEDERAL MINISTRY OF EDUCATION

NATIONAL LANGUAGE CENTRE DIVISION

6, OBANTA ROAD, APAPA

When replying, please quote earlier reference

P.M.B. No. ....

Telegrams Sceducate

Telephone 875792



Ref. No. FME/LC/88/IV/T/14

Date 19th October, 1987

Mr. Victor Manfredi,  
William James Hall,  
Department of Anthrogeology,  
Harvard University,  
Massachusetts 02138,  
U. S. A.

Dear Mr. Manfredi,

## RE-PAN NIGERIAN TYPEFACE

I am directed to acknowledge, with thanks the receipt of your letter dated 30th July, 1987.

We are, however, writing to inform you that it may not be possible to retain the earlier proposed date of January 20 to January 22, 1988 for the signing of the Agreement. On closer consideration, the Ministry regards the January, 1988 date as inconvenient, since it falls at the beginning of the financial year. The Ministry, therefore, suggests that final negotiations should take place in the first or second week of March, 1988. Please indicate whether this new date is suitable.

Your co-operation is highly appreciated.

Yours truly,

A handwritten signature in dark ink, appearing to read 'M. U. Gbinoshe-Ariawhorai'.

M. U. GBINOSHE-ARIAWHORAI (MRS)  
for: Permanent Secretary.

*replied  
28 Nov*



# CHAMBER OF COMMERCE HISPANO — NIGERIAN

## CAMARA DE COMERCIO ASOCIADA HISPANO — NIGERIANA

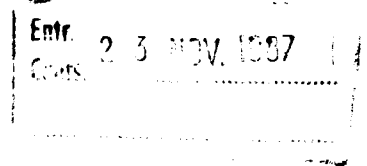
Madrazo, 32, 1º 2º - Teléfonos: 237 93 20 - 237 95 84 - Telex: 81069 HLINE - Apartado de C. 5374  
08006 BARCELONA - Spain

Sres.

FUNDICION TIPOGRAFICA NEUFVILLE, S.A.

C/ Travesera de Gracia, 183

08012 BARCELONA



20 Noviembre de 1987.

Muy Sres nuestros:

La presente es para comunicarles que hemos recibido su atenta carta del 17 de los corrientes.

A continuación les detallamos nombre y dirección de proveedores para la Industria Gráfica en Nigeria, que nos pedían:

1. Afrographic Equipment & Supplies Co.  
BOX 623  
Lagos, Nigeria.
2. Igbalaye Printing Machinery & Co. LTD  
BOX 273 Oshogbo  
Nigeria.
3. Intergrafica Nigeria LTD  
BOX 567, Apapa  
Lagos, Nigeria  
Telex 22200 TDS NG 020.
4. Briscoc R.T. (Nig) LTD  
Sl. Agege Motor Road  
Lagos, Nigeria.
5. Nigerian Lithographic Ind. LTD  
BOX 373 Yaba  
Telex 26628 MGLIT. *ph*
6. Ollivant G.B. (Dir of N.A.C.)  
58, Marina BOX 1081 Lagos, Nigeria.

Esperando que dicha información les sea de utilidad, aprovechamos la ocasión para saludarles muy atentamente.

CAMARA DE COMERCIO ASOCIADA HISPANO-NIGERIANA.

R.P.



# FEDERAL MINISTRY OF EDUCATION

LANGUAGE DEVELOPMENT CENTRE

6, OBANTA ROAD, APAPA.

DIVISION

Enit. 29 AGO. 1988

Contrs. 26/9/88

P.M.B. No. \_\_\_\_\_

Telegram \_\_\_\_\_

875792

Telephone \_\_\_\_\_



Ref. No. FME/LC/88/Vol.V/485

1st July, 1988

Mr. Wolfgang Hartmann,  
Fundicion Tipografica,  
Neufville, S. A.  
Travesera de Graaa, 183  
08012 Barcelona,  
Spain.

Dear Mr. W. A. Hartmann,

Re: Pan Nigerian Typewriter and Typeface Agreement.

This is to acknowledge the receipt of your letters of the 21st December, 1987 and the 10th January, 1988. Your request to postpone the meeting in March 1988 has been noted.

Please select another date, preferably in October or November 1988, when it will be convenient for you to come to Lagos to sign the agreement.

An early reply will be highly appreciated.

Yours truly,

M. U. Gbinoshe - Araiwhorai (Mrs)

for: Honourable Minister of Education.



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NEUFVILLE, S. A.

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Central en  
Travesera de Gracia, 183 08012-Barcelona  
Teléfono 219 05 00 Telefax 214 26 07  
Teleg.: Neufville-Barcelona Telex 54 510

URGENTE / EXPRESS

Mr. Victor MANFREDI  
c/o HARVARD UNIVERSITY  
Department of Anthropology  
William James Hall 427  
CAMBRIDGE, MA 02138  
U S A

Su carta del:

Nuestra referencia:

WH/wi.

Fecha: September 26, 1988

Dear Victor:

Enclosed please find a copy of the letter of the FEDERAL MINISTRY OF EDUCATION from Nigeria, which I only received beginning of September after vacation and participation to IPEX. Can we plan to travel together to talk to these people? When would you be in disposition to travel, in December or January?

Please give me an immediate reply.

Enclosure.

Yours cordially,

Wolfgang A. Hartmann  
Gerente

# UNIVERSITY OF PORT HARCOURT

Managing Editor:-

Uwaezuoke Nkwocha B. A. (Nig.)

Telephone: 300440-9 Lines Extn 376

Telegrams University Pharcourt



EAST-WEST ROAD  
CHIBA  
P. M. B. 5323  
PORT HARCOURT  
NIGERIA.

Our Ref UPH/PH/14

28th June 1989

## PUBLISHING HOUSE

Mr. Victor Manfredi  
427 WJH  
Harvard University  
Cambridge MA 02138  
U.S.A

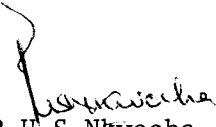
Dear Mr. Manfredi,

Prof. Kay Williamson said you could advise me on how to obtain a necessary software that carries characters of various Nigerian Languages.

We have the Macintosh SE of 1986/87 model and are actively establishing a typesetting office. Naturally, we should be interested in typesetting texts in the local languages.

We have heard of JolanPanNigerian created by you and Edward Oguejiofo. Is it possible to have it adapted for use in our Macintosh? How much will that be? Please advise.

Yours Sincerely,

  
P. U. S. Nkwocha

PAN NIGERIAN

14,761

MANFKBD1 - PROPORTION

OLD CAP HEIGHT

perhaps by special casting

type body  
ascender line

cap height NEW

x-height  
lower case

for D B

base line

2 mm in sample

descender line  
type body

NEW BODY  
LINE?

10' 3,514 mm 16' 5,623  
12' 4,217 18' 6,326  
14' 4,920 24' 8,435

20' 7,029  
28' 9,814

36 42' 14,761

smaller size 14 pt. 10 pt. 12 pt. Price

**PanNigerian**, a multilingual PostScript outline-font family with custom keyboard software developed by Edward Oguejiofor and Victor Manfredi, 1985 - 86 in cooperation with the National Language Centre, Federal Ministry of Education, Lagos Nigeria. **PanNigerian** is a serif roman based on the Bauer letterpress font **Impressum** [courtesy of Fundición Tipográfica Neufville, Travesera de Gracia 183, Barcelona 08012 Spain] with technical assistance from Hermann Zapf, Darmstadt BRD. Test proof for **JOLAN** no. 3 (1985) in 12- and 14-pt. on Mergenthaler Linotronic 300.

103 PanNigerian characters (unit-stored individual diacritic combinations)

B b K k  
m m n n á a ä ä æ é è ê ê  
é è ē ē ē ī î ï ï ï ï  
ó o ô ô ó o ú u û û u ú u û û

B D K S  
 M N M̄ N̄ N̄ N̄ Á À Ā Ǝ É È Ǝ  
 É È Ǝ Ǝ É È Í Ì Î Ï Ì Ì Ì Ì  
 Ó Ò Ō Ō Ó Ò Ō Ú Û Ü Ü Ú Û Ü

ă ą ǣ ȝ  
 á â ã ä å æ ç è é ê ë  
 í î ï ð ñ ò ó ô õ ö ø ù ú û ü

B D K S  
 M N M N N N N Á À Ā Ǽ Ǽ Ǽ  
 É È Ē Ē Ē Ē Ē Í Î Ï Ï Ï Ï  
 Ó Ò Ō Ō Ō Ō Ō Ú Û Ü Ü Ü Ü

b d k s  
 m n m̄ n̄ á à ā â é é̄ ē ē̄  
 é è ē ê ẹ ẹ̄ ẹ̄̄ ị ị̄ ị̄̄ ị̄̄̄  
 ó ò ô õ o ō ō̄ u ū ū̄ ū̄̄

ʼ Ɓ ɗ Ƙ Ƨ  
 Á À Ā Ă Ä Æ É Ê Ë  
 Í Î Ï Į İ Ĳ  
 Ó Ò Ō Ő Ű Ú Û Ü

**b d k s  
 m n m̄ n̄ á à ā â ə é è ē ê  
 é è ē ê ę ẹ ẹ ẹ ẹ í ì î ï ï ï ï ï  
 ó ò ô õ ọ ọ ọ ọ ọ ú ù ū û u ú ù ū ū**

ʒ ɖ ƙ ɣ  
 ́ ̂ ̃ ̄ ̅ ̆ ̇ ̈ ̉ ̊ ̋ ̌ ̍ ̎ ̏ ̐ ̑ ̒ ̓ ̔ ̕ ̖ ̗ ̘ ̙ ̚ ̛ ̜ ̝ ̞ ̟ ̠ ̡ ̢ ̣ ̤ ̥ ̦ ̧ ̨ ̩ ̪ ̫ ̬ ̭ ̮ ̯ ̰ ̱ ̲ ̳ ̴ ̵ ̶ ̷ ̸ ̹ ̺ ̻ ̼ ̽ ̾ ̿ ̀ ́ ͂ ̓ ̈́ ͅ ͆ ͇ ͈ ͉ ͊ ͋ ͌ ͍ ͎ ͏ ͐ ͑ ͒ ͓ ͔ ͕ ͖ ͗ ͘ ͙ ͚ ͛ ͜ ͝ ͞ ͟ ͠ ͡ ͢ ͣ ͤ ͥ ͦ ͧ ͨ ͩ ͪ ͫ ͬ ͭ ͮ ͯ Ͱ ͱ Ͳ ͳ ʹ ͵ Ͷ ͷ ͸ ͹ ͺ ͻ ͼ ͽ Ϳ ̀ ́ ͂ ̓ ̈́ ͅ ͆ ͇ ͈ ͉ ͊ ͋ ͌ ͍ ͎ ͏ ͐ ͑ ͒ ͓ ͔ ͕ ͖ ͗ ͘ ͙ ͚ ͛ ͜ ͝ ͞ ͟ ͠ ͡ ͢ ͣ ͤ ͥ ͦ ͧ ͨ ͩ ͪ ͫ ͬ ͭ ͮ ͯ Ͱ ͱ Ͳ ͳ ʹ ͵ Ͷ ͷ ͸ ͹ ͺ ͻ ͼ ͽ Ϳ

## 18 additional phonetic characters for linguistics

ŋ ɰ ɾ ɣ ã ǣ ě ε ẽ ĩ ı ĩ õ ɔ ɔ̃ ũ ʊ ỹ

ṁ ʁ ʀ ʁ ã ă ě ε ě ĭ ĩ ẽ ̃ ̄ ̅ ̆ ̇ ̈ ̉ ̊ ̋ ̌ ̍ ̎ ̏ ̐ ̑ ̒ ̓ ̔ ̕ ̖ ̗ ̘ ̙ ̚ ̛ ̜ ̝ ̞ ̟ ̠ ̡ ̢ ̣ ̤ ̥ ̦ ̧ ̨ ̩ ̪ ̫ ̬ ̭ ̮ ̯ ̰ ̱ ̲ ̳ ̴ ̵ ̶ ̷ ̸ ̹ ̺ ̻ ̼ ̽ ̾ ̿ ̀ ́ ͂ ̓ ̈́ ͅ ͆ ͇ ͈ ͉ ͊ ͋ ͌ ͍ ͎ ͏ ͐ ͑ ͒ ͓ ͔ ͕ ͖ ͗ ͘ ͙ ͚ ͛ ͜ ͝ ͞ ͟ ͠ ͡ ͢ ͣ ͤ ͥ ͦ ͧ ͨ ͩ ͪ ͫ ͬ ͭ ͮ ͯ Ͱ ͱ Ͳ ͳ ʹ ͵ Ͷ ͷ ͸ ͹ ͺ ͻ ͼ ͽ Ϳ ̀ ́ ͂ ̓ ̈́ ͅ ͆ ͇ ͈ ͉ ͊ ͋ ͌ ͍ ͎ ͏ ͐ ͑ ͒ ͓ ͔ ͕ ͖ ͗ ͘ ͙ ͚ ͛ ͜ ͝ ͞ ͟ ͠ ͡ ͢ ͣ ͤ ͥ ͦ ͧ ͨ ͩ ͪ ͫ ͬ ͭ ͮ ͯ Ͱ ͱ Ͳ ͳ ʹ ͵ Ͷ ͷ ͸ ͹ ͺ ͻ ͼ ͽ Ϳ

ŋ ɰ ɹ ɻ ã ǣ ĕ ɛ ĕ ĭ ĩ ȩ Ȯ Ȱ Ȳ ȳ ȴ

ἡ υ ρ η ã õ ĕ ε ě ĭ ĩ ō ɔ ǝ ū υ ũ

52 plain roman characters plus 10 figures, 26 punctuation marks

nanbncndnenfnngnhninjnknlnmnonpnqnrnsntrunvnwnxnynzn<(((1234567890)))>+.=@.#\*'"...;

NANBNCNDNEFNGNHNINJNKNLNMNONPNONRNSNTNUNVNWNXNYNZN!/?/\%

nanbncndnenfnngnhninjnknlnmnonpnqnrnsntnunvnwnxnynzn

NANBNCNDNE NFN GNHNINJKNLNMNONPNQNRNSNTNUNVNWNXNYNZ

N:({ 1234567890)}+ = @ # ' " ! ? . : ; / \ %



!"#%&'()\*+,-./  
 0123456789:;<=>?  
 @ABCDEFGHIJKLMNO  
 PQRSTUVWXYZ[ \ ] ^  
 `àáâãäåæçèéêë  
 ìíîïïïïïïïïï  
 ùúûüýþÿÀÁÂÃÄÅ  
 ÆÇÈÉÊËÌÍÎÏ  
 ÑÒÓÔÕÖØÙÚÛÜÝ  
 Þßàáâãäåæçèéêë  
 ìíîïïïïïïïïï  
 ùúûüýþÿÀÁÂÃÄÅ  
 ÆÇÈÉÊËÌÍÎÏ  
 ÑÒÓÔÕÖØÙÚÛÜÝ  
 Þß

# Pan Nigerian characters with old key mapping

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
								O-u A	O-i á e e	OPT t î	OPT 5 ù	S-O / ñ	OPT - 3	S-O 7 ó	S-O k M
								S-O a à	O-u e é	S-O 8 2	S-O = ū	OPT 1 ñ	S-O - 3	S-O 9 o	S-O ñ
								S-O c ā	O-e i è	OPT 4 ã	OPT , â	OPT l y	OPT I É	S-O 8 o	S-O ; Ñ
								O-e <sup>131</sup> E â	O-i <sup>142</sup> i ē	OPT <sup>133</sup> 3 ó	OPT - ũ	OPT v y	S-O I É	S-O w q	S-O z Ñ
								O-n N ã	O-i i ê	OPT 6 ò	OPT y y	OPT f m	OPT I É	S-O e ó	S-O x Ñ
								O-u O ɔ	O-u i ε	OPT 8 o	OPT m ũ	OPT x m	S-O I É	S-O r q	S-O b B
								O-u U ó	O-n n ē	OPT 7 ô	OPT d ù	OPT <sup>131</sup> j b	OPT / É	S-O t q	S-O n D
								O-e a à	O-e o í	OPT s õ	OPT w ũ	OPT d \	S-O v É	S-O y ũ	S-O m K
								O- a ā	O- i ì	OPT r o	S-O p ũ	S-O k \	O-u y É	S-O u ũ	S-O , S
								O-i a â	O-i o ī	OPT g ó	OPT p u	OPT ; f	S-O I É	S-O i ũ	S-O /
								O-u a ā	O-u o î	OPT 2 ô	OPT b ũ	OPT SPC	S-O I É	S-O s ũ	OPT h
								O-n a é	O-n o ï	O-e o õ	OPT 9 m	O- A Á	S-O 2 I	S-O d ũ	OPT k
								OPT a è	O-e u ï	O-u o õ	OPT 8 m	O-n A À	S-O 3 I	S-O f ũ	
								OPT c ē	O- u ï	OPT = 3	OPT z m	O-n O A	S-O 4 I	S-O g ũ	
								O-e e ê	O-i u ì	S-O 5 ñ	OPT h q	S-O 3 É	S-O 5 I	S-O h M	
								O- e ē	O-u u ī	S-O o ũ	OPT o ñ	OPT q É	S-O 6 I	S-O j M	

90 Pan-Nigerian leaded characters

Ḇ ḏ Ḑ ḑ

Ḑ Ḑ Ḑ Ḑ

ḡ ḡ ḡ ḡ ḡ ḡ ḡ ḡ

Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ

Ḣ Ḣ Ḣ Ḣ Ḣ Ḣ Ḣ Ḣ

Ḣ Ḣ Ḣ Ḣ Ḣ Ḣ

Ḥ Ḥ Ḥ Ḥ Ḥ Ḥ Ḥ Ḥ

Ḥ Ḥ Ḥ Ḥ Ḥ Ḥ

Ḧ Ḧ Ḧ Ḧ Ḧ Ḧ Ḧ Ḧ

Ḧ Ḧ Ḧ Ḧ Ḧ Ḧ

Ḩ Ḩ Ḩ Ḩ Ḩ Ḩ Ḩ Ḩ

Ḩ Ḩ Ḩ Ḩ Ḩ Ḩ

Ḫ Ḫ Ḫ Ḫ Ḫ Ḫ Ḫ Ḫ

Ḫ Ḫ Ḫ Ḫ Ḫ Ḫ

Ḇ ḏ Ḑ ḑ

Ḑ Ḑ Ḑ Ḑ

ḡ ḡ ḡ ḡ ḡ ḡ ḡ ḡ

Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ Ḡ

Ḣ Ḣ Ḣ Ḣ Ḣ Ḣ Ḣ Ḣ

Ḣ Ḣ Ḣ Ḣ Ḣ Ḣ

Ḥ Ḥ Ḥ Ḥ Ḥ Ḥ Ḥ Ḥ

Ḥ Ḥ Ḥ Ḥ Ḥ Ḥ

Ḧ Ḧ Ḧ Ḧ Ḧ Ḧ Ḧ Ḧ

Ḧ Ḧ Ḧ Ḧ Ḧ Ḧ

Ḩ Ḩ Ḩ Ḩ Ḩ Ḩ Ḩ Ḩ

Ḩ Ḩ Ḩ Ḩ Ḩ Ḩ

Ḫ Ḫ Ḫ Ḫ Ḫ Ḫ Ḫ Ḫ

Ḫ Ḫ Ḫ Ḫ Ḫ Ḫ

18 additional phonetic characters for linguistics

ḡ ḡ ḡ ḡ

ḡ ḡ ḡ ḡ ḡ ḡ ḡ ḡ

ḡ ḡ ḡ ḡ

ḡ ḡ ḡ ḡ ḡ ḡ ḡ ḡ

103 Pan-Nigerian characters (including unit-stored individual diacritic combinations)

B D K S

Á À Ã Ä Å Æ Ç

Á À Ā Э Э̄ Э̅

É È Ē E É Ê Ē

$$\bar{I} \bar{I} \bar{I} \quad \bar{I} \bar{I} \bar{I}$$

Ó Ò Ō ○ Ó Ò Ō

Ú Ò Û Ü Ý Þ ß

B D K S

Á À Ã Ä Å Æ Ç È É Ê Ë

Á À Ā É É È Ē

É È Ē E É È Ē

$$\acute{I} \grave{I} \bar{I} \quad I \acute{I} \grave{I} \bar{I}$$

Ó Ò Ò Ó Ó Ò Ò

$$\acute{U} \grave{U} \bar{U} \cdot U \acute{U} \grave{U} \bar{U}$$

NANBNCNDNENFNGNHNIJNKNLNMNONPNQNRNSNTNUVNVWNXNYNZN!/?\|%

## Setting PanKwa type on the Macintosh

*PanKwaPalatino*<sup>1</sup> includes all orthographic characters for the 12 federal Nigerian languages; for adjacent Kwa languages such as Gbè, Akan, Ànyĩ; and for Kru languages. To set PanKwa type requires *MacKeyméléon*, *Choix de Claviers* DA, *Laserwriter Utility*, a bitmap family (*PanKwaPalatino-Roman.fam*) and 4 Postscript type-1 outlines (*PanKwaPalRom/Ital/Bol/BolIta*). Install *PanKwaPalatino-Roman.fam* in the System file (or open it from the Suitcase II DA), and drag *Laserwriter Font Utility* and *PanKwaPalRom* etc. into the System Folder. (Note: in the QuickDraw screen format -- used by printers like Stylewriter which don't accept downloaded PostScript -- *PanKwa* is smoothed by Adobe Type Manager.)

Open the *PanKwa* keyboard with *MacKeyméléon*, and do "Installer" (under the "Fichier" menu). In a document (with the *PanKwa* keyboard selected by *Choix de Claviers*), each diacritic or special symbol is produced by holding down (Shift) Option plus an alphabetic or numeric key. For example, lower case *ɔ* is produced by Option-1 (for the low tone) plus *o* (Option-o), while upper case *Ȭ* is produced by Option-1 (for the low tone) plus *Q* (Shift-Option-o): *ȬȬ*. Here is the full list:

To get:	$\begin{Bmatrix} \text{ɛ}/\text{È} & \text{'dotted e'} \\ \text{ɪ}/\text{Ì} & \text{'dotted i'} \\ \text{ɔ}/\text{Ȭ} & \text{'dotted o'} \\ \text{u}/\text{Ȫ} & \text{'dotted u'} \\ \text{ɘ}/\text{Ȥ} & \text{'dotted s'} \\ \text{ŋ}/\text{Ȫ} & \text{'(nonsyllabic) velar nasal'} \end{Bmatrix}$	type:	$\begin{Bmatrix} \text{(Shift) Option e} \\ \text{(Shift) Option i} \\ \text{(Shift) Option o} \\ \text{(Shift) Option u} \\ \text{(Shift) Option s} \\ \text{(Shift) Option n} \end{Bmatrix}$	.
To get:	$\begin{Bmatrix} \text{ɓ}/\text{ʼB} & \text{'implosive/glottalized b'} \\ \text{ɗ}/\text{ʼD} & \text{'implosive/glottalized d'} \\ \text{ɗ}/\text{ʼD} & \text{'implosive/glottalized d'} \\ \text{k}/\text{K} & \text{'ejective k'} \\ \text{g} & \text{'implosive/glottalized g'} \\ \text{y} & \text{'implosive/glottalized y'} \end{Bmatrix}$	type:	$\begin{Bmatrix} \text{(Shift) Option b} \\ \text{(Shift) Option d} \\ \text{(Shift) Option x} \\ \text{(Shift) Option k} \\ \text{Option c} \\ \text{Option y} \end{Bmatrix}$	.
To get:	$\begin{Bmatrix} \text{f}/\text{F} & \text{'voiceless bilabial fricative'} \\ \text{v}/\text{V} & \text{'voiced bilabial fricative'} \\ \text{ɣ}/\text{X} & \text{'voiced velar fricative'} \\ \text{ʃ}/\text{S} & \text{'voiceless alveolar fricative'} \end{Bmatrix}$	type:	$\begin{Bmatrix} \text{(Shift) Option p} \\ \text{(Shift) Option v} \\ \text{(Shift) Option g} \\ \text{(Shift) Option z} \end{Bmatrix}$	.
To get:	$\begin{Bmatrix} \text{ə}/\text{Ȥ} & \text{'schwa'} \\ \text{ɛ}/\text{È} & \text{'epsilon'} \\ \text{ɪ} & \text{'iota'} \\ \text{ɔ}/\text{Ȭ} & \text{'turned c'} \\ \text{ʊ} & \text{'upsilon'} \\ \text{ɲ} & \text{'palatal nasal'} \\ \text{ŋ}/\text{Ȫ} & \text{'velar nasal'} \\ \text{ɱ} & \text{'labiovelar nasal'} \\ \text{ʋ} & \text{'unrounded u'} \end{Bmatrix}$	type:	$\begin{Bmatrix} \text{(Shift) Option a} \\ \text{(Shift) Option 1} \\ \text{Option 2} \\ \text{(Shift) Option 3} \\ \text{Option 4} \\ \text{Option 5} \\ \text{(Shift) Option 6} \\ \text{Option 7} \\ \text{Option 8} \end{Bmatrix}$	.
To get:	$\begin{Bmatrix} \text{ˊ} & \text{'high tone'} \\ \text{ˋ} & \text{'low tone'} \\ \text{ˊ} & \text{'mid tone/macron'} \\ \text{ˋ} & \text{'breve/short syllable'} \\ \text{ˆ} & \text{'falling tone'} \\ \text{ˊ} & \text{'rising tone'} \\ \text{ˋ} & \text{'tilde'} \\ \text{ˊ} & \text{'Methodist downstep'} \\ \text{¨} & \text{'umlaut'} \\ \text{ˊ} & \text{'low-rising tone'} \\ \text{ˊ} & \text{'mid-rising tone'} \\ \text{ˋ} & \text{'high-falling tone'} \\ \text{ˋ} & \text{'mid-falling tone'} \\ \text{.} & \text{'subdot'} \end{Bmatrix}$	type:	$\begin{Bmatrix} \text{Option h} \\ \text{Option l} \\ \text{Option m} \\ \text{Option q} \\ \text{Option f} \\ \text{Option r} \\ \text{Option t} \\ \text{Option ' (single quote)} \\ \text{Option 9} \\ \text{Option l, then plain r} \\ \text{Option m, then plain r} \\ \text{Option h, then plain f} \\ \text{Option m, then plain f} \\ \text{Option . (period)} \end{Bmatrix}$	followed by any letter. <sup>2</sup>

<sup>1</sup>Created with Fontastic, Fontographer, StyleMerger (Altsys Corp., 269 Renner RD, Richardson TX, 75080, (214) 680-2060) and MacKeyméléon (Logiciel Avenue, 2162 boul. Charest Ouest, Sainte-Foy QC Canada G1N 2G3, (418) 682-6968). Thanks to Hermann and Gudrun Zapf, Federal Ministry of Education (Lagos), Edward ȬgwejiȬfȬ, Victor Manfredi, Kofi Anyidoho and Hounkpati Capo.

<sup>2</sup>I.e., type the diacritic before the letter. Superscript a tilde by 2 or more points to combine it with an upper-case letter.



H. O. S. A.

INGENIERIA

DIB. VER.

ES

GNIO DEL TIPO DE ESCRITURA

CODIGO ESCRITURA

2-4-70

50 127-9-78

P

Vegetal

1461

3054

NIGERIA

Copia

1461

6390

0 Eje horizontal pica

Eje vertical

0,3

2.225

2.475

3

925



El tipo se tolera minimo a 2,5

2,52

CANJEAR 27 9

ENTREGA..

M. O. S. A.

INGENIERIA

COMANDO EN JEFE

ESTADO MAYOR

Vegetal

6520

8851

NIGERIA

Eje vertical

1.29

0.545

0

Eje horizontal

1.335

(2.025)

Copia

6520

8851

ENCUENTRO  
ANTIGUO

Vegetal  
6520  
6351

H. O. S. A.

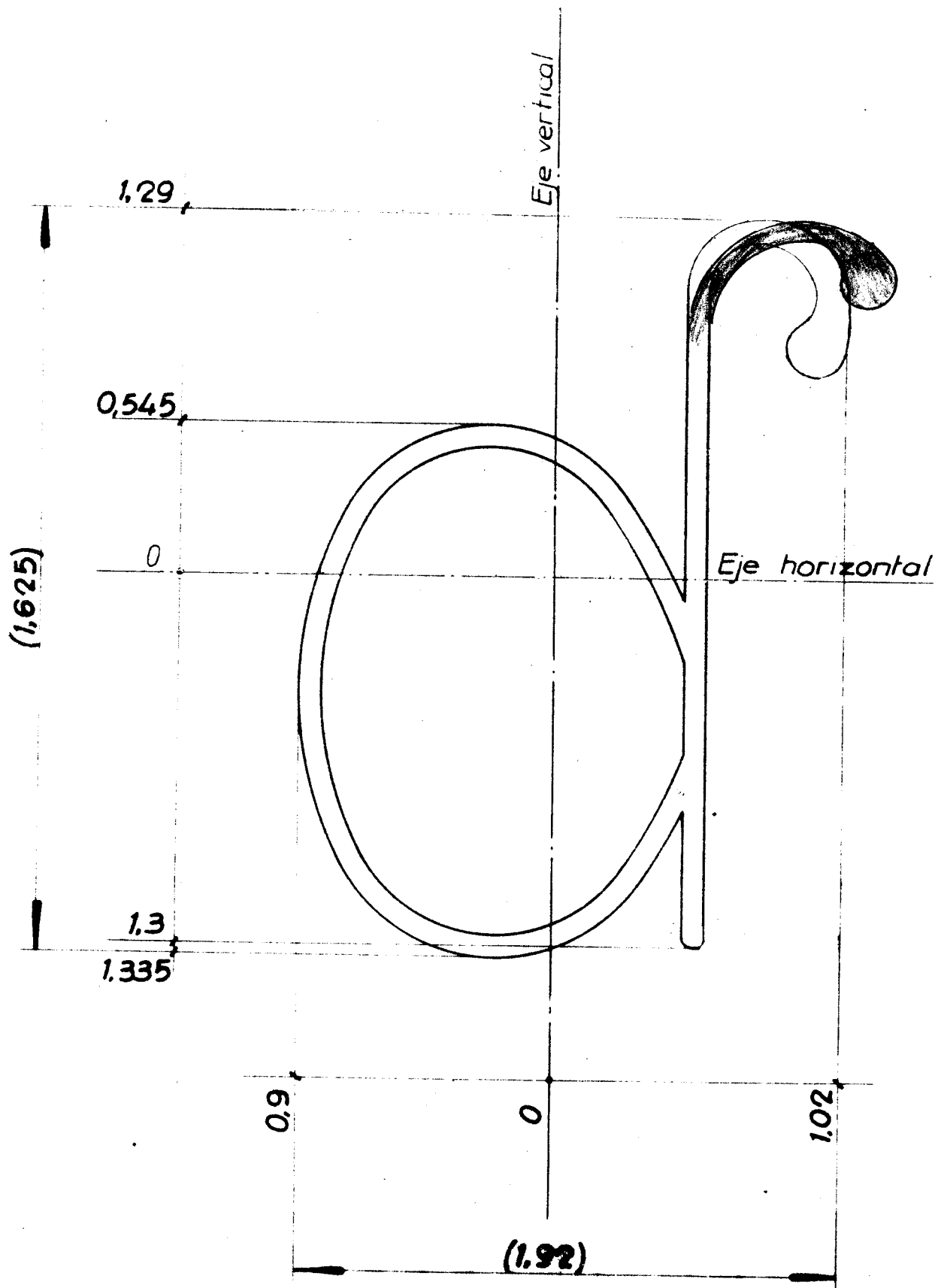
INGENIERIA

LONGO DEL TIPO DE ESCRITURA						
DIB	TEX	ESC	20-3-70			
Maria	ca	50:1				2

LONGO DEL TIPO DE ESCRITURA

NUMERO DIBUJO

NIGERIA



Copia  
6520  
6351

CANJEAR  
ENTREGAR

H. O. S. A.

INGENIERIA

SIGNO DEL TIPO DE ESCRITURA

DIB.°

VERF.°

ESC.

24-3-70

CODIGO ESCRITURA

002

NUMERO DIBUJO

0011 Inf.

Vegetal

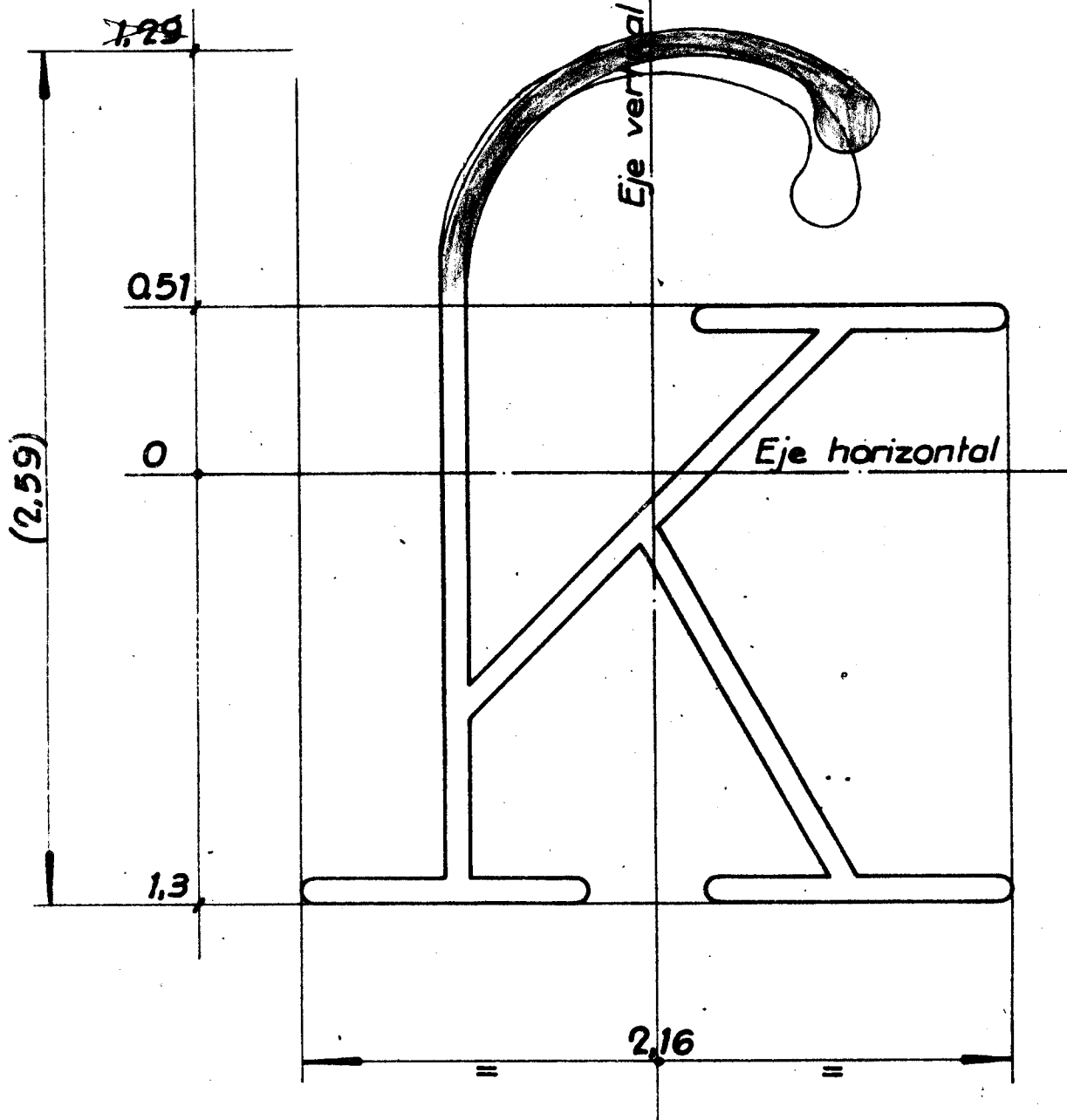
6520

6551

OMSA

NIGERIA

VERSION 1



Copia

6520

6551

CANJEAR  
ENTREGAR

H.O.S.A.

INGENIERIA

DISE.

VERIF.

LOC.

SECCION DE TIPO DE PLANTA

11-11-70

50%

PROYECTO DE PLANTA

SECCION DE TIPO

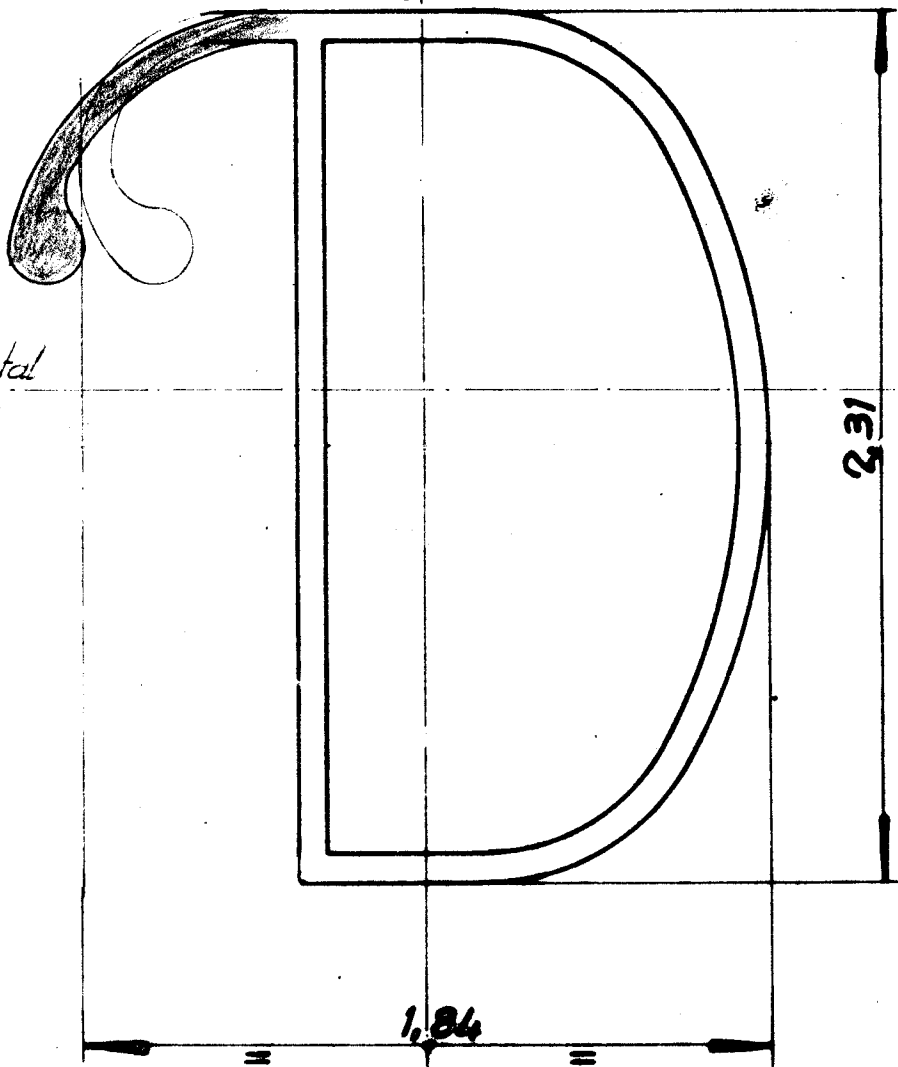
NIGERIA

Eje vertical

Eje horizontal

2,31

1,84



Vegetal  
6520  
6351

H.O.S.A.  
INGENIERIA

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20

30.7

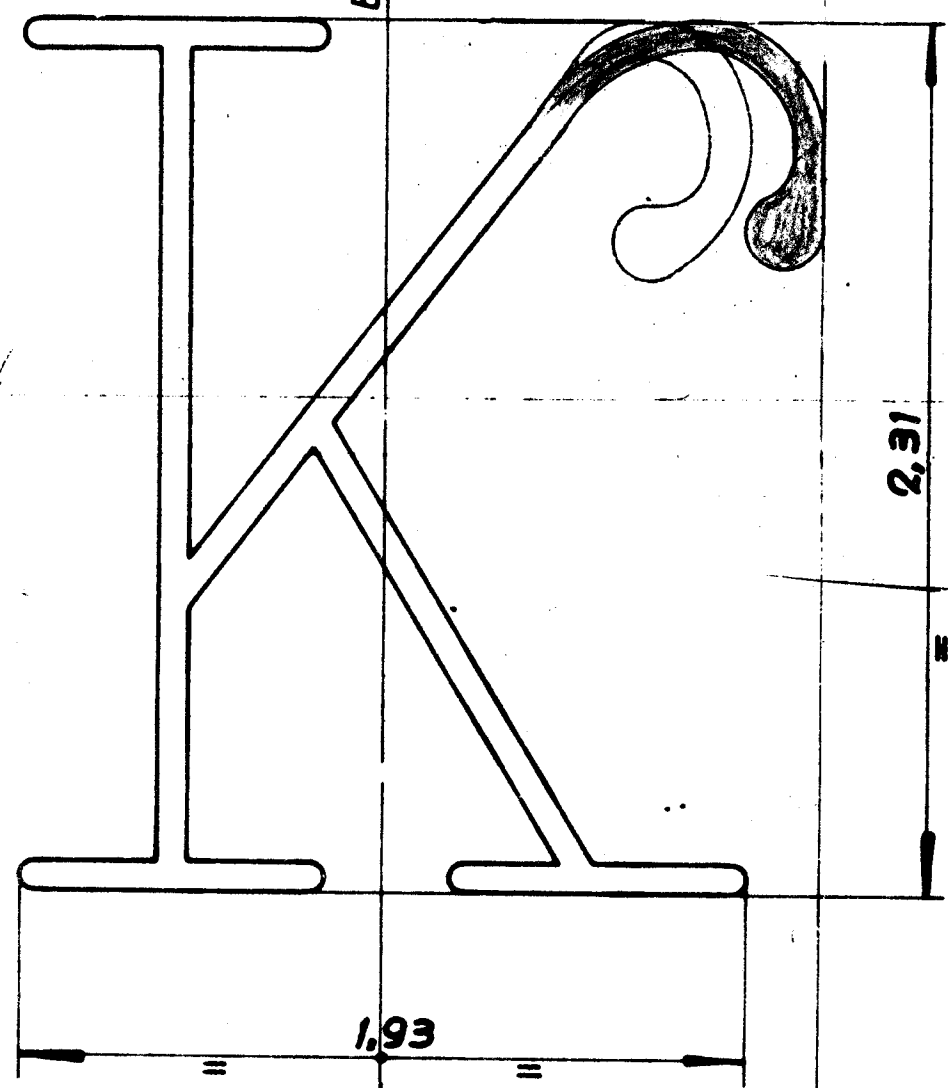
NIGERIA

VERSION 1

Copia  
6520  
6351

Eje horizontal

Eje vertical



CARTRON  
MEXICANA

# Window

March 30, 1987

Harvard University

Vol. I, No. 7

## OIT Announces Fast New Laser Printer

On April 1, OIT will make a new Xerox 4050 printer, which can print 50 pages per minute, available to the Harvard community. This printer provides high-quality laser output equal to the HP Laserjet and graphics comparable to Apple's LaserWriter. The Xerox can print six to ten times faster than either of the two desktops and twice as fast as OIT's IBM 6670 laser printer.

The Xerox 4050 can produce a variety of professional font sizes and faces (similar to Times, Helvetica, and Optima), as well as diacritic markings, on different weights of paper, both vertically and horizontally. Attached to OIT's IBM 3083 mainframe computer, the printer will be available to users of VM/CMS for FOCUS, SAS, PL/I and many other applications and procedural languages. Able to print most data processing listings and CMS files, the printer uses cut-sheet paper rather than the more traditional fanfold type with holes along both sides. It can print on three-hole punched and letterhead paper as well.

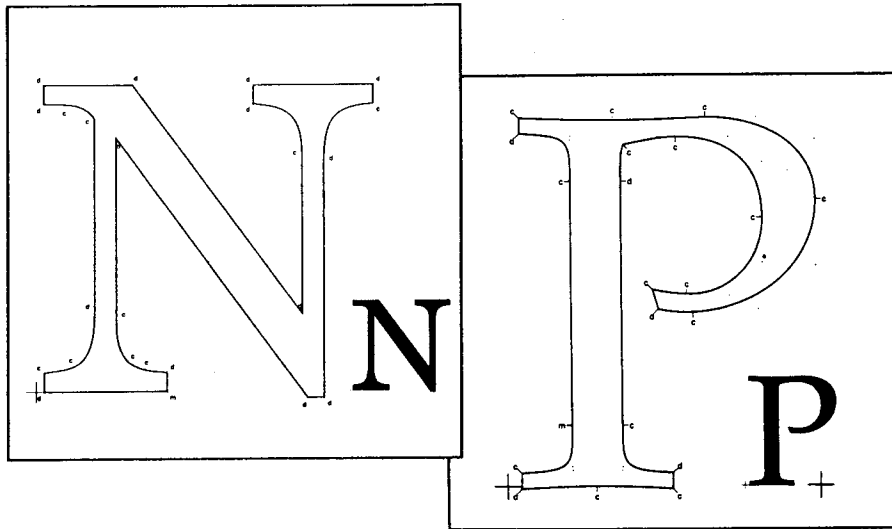
Especially interesting for users of SCRIPT is the new printer's typographic capabilities, including diacritic markings for most fonts. The 4050 can also support graphics created in SAS/Graph with a printing resolution of 300 dots per inch, producing camera-ready output for graphics, reports and other publications. In the future, graphics files from other application programs will also be supported by the new printer.

OIT expects the 4050 will be able to support database and on-demand publishing applications, including those for non-roman languages, and plans to provide additional typographic fonts and space-saving printing options.

At \$.07 per page, output from the new printer will cost less than that from the IBM 6670. On-line documentation is available to CMS users as part of the on-line help files.

For information about printing SAS/Graph files, call Harry Heermans (495-4656). For information about typesetting using SCRIPT and the 4050 printer, call Zack Deal (495-4793). Call Rick Whalen (495-3230) about using letterhead paper and forms with the new printer.

Zack Deal



## Letters, Words, and Papers: Printing and Fonts at Harvard

Members of the Harvard community now have several different options for producing books, journals, papers, reports, and newsletters. They can choose the traditional method of sending manuscripts to a professional printer (with the Office of the University Printer being one of many possibilities); they can send computer disks or files to a professional printer; they can obtain hard-copy output from desktop laser printers or, for users of the mainframe, from the new OIT Xerox 4050 laser printer (see this page); or they can have their computer files (in PostScript) printed out on the very high-quality (up to 2540 dots per inch) Linotronic 300P in William James.

"The Linotronic and the LaserWriter are totally compatible, and any software that can run on the LaserWriter can be used with the Linotronic," assures Scott Bradner, in charge of the system on the twelfth floor of William James. The facility at William James is able to handle disks with MacWrite files directly, but if you are using Page-Maker, Microsoft Word, or JustText (or any other special software), you will

need to bring the software with you as well. Some publications that regularly obtain hard copy from the Linotronic at William James are the *Harvard Theological Review*, *The Russian Review*, and *Harvard Ukrainian Studies*. For more information about printing on the Linotronic, call Scott Bradner at 495-3864.

Principally geared to do large or regular jobs at the rate of \$.45 per inch on 8-inch wide paper, the William James facility will also take smaller jobs through an arrangement with OIT. The charge for smaller jobs is \$8 per page, with a \$15 minimum. For smaller jobs, call Zack Deal at 495-4793 or 495-3242.

Continued on page 3

## Macintosh and PostScript Technology for Nigerian Languages

Nigeria's 100 million people speak 450 languages, but difficulties in processing and typesetting them have hampered publication of material sufficient to meet people's needs. While these languages have used Roman-based script since the 1860's, the 26-character alphabet cannot represent distinctive sounds in even the three largest of the Nigerian languages, Hausa, Igbo, and Yoruba. The flexibility of Macintosh computers and the simplicity of high-quality PostScript outline fonts promise improved printing capabilities in all the languages at appropriate levels of quality and cost.

Using Fontographer (see description elsewhere on this page), each character can be defined as a PostScript outline that will print at the appropriate resolution on the Apple LaserWriter (300 dots per inch), as well as on the Allied Linotronic 300 (3000 dots per inch, comparable to the best quality available from commercial typesetters). With the new Fontographer release, diacritics can be added to existing fonts like Times or Helvetica (or fonts can be designed and created from scratch). Continued on page 3

## From the Director: Information Utilities

Depending on your individual need, you can get assistance from the Office for Information Technology and other service departments at Harvard in many different ways. In the Office for Information Technology we offer some of our services as public utilities, some as custom contracts, some as retail services, and some as management or personal services. Wherever there is a high volume of activity or requests, we are attempting to package our services as utilities to provide the greatest value to the largest community in the least cost way.

Over the years, the University Telephone Service and the Harvard Computing Center timesharing service have been some of the more popular or better known utilities. Within a couple of years we expect the Telephone Service to grow into a campus-wide voice and data network.

We expect those who have built central administrative databases will share the information they have collected through an information utility. The University library is well on its way toward putting its catalog on line, which will be the precursor of a University Library Utility. Several of the data centers on campus have significant research and public databases to share with others. These on-line databases will become network-based information services after a campus network is installed.

Many of the future utilities depend on a campus network for access to and delivery of information. While it will be several years before this environment will be fully developed, one of the future utilities of OIT is currently under development and can be used today. That utility is electronic publishing.

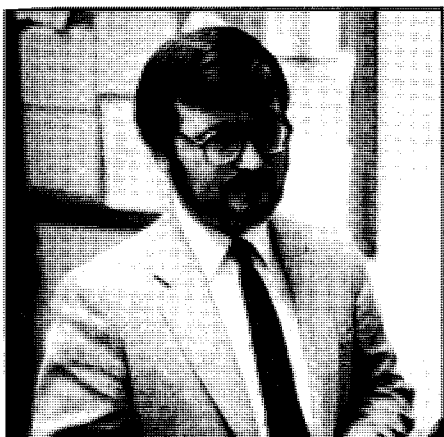
Your needs may range from simple text entry to final camera-ready copy. You may be interested in basic or specialized fonts, in text editing or page layout, in a desktop device or in a high-volume, high-resolution printer. All these capabilities are now being piloted in OIT and other service locations in the University. To give you some idea of these capabilities, this issue of the *Window* focuses much of its attention on electronic publishing at Harvard.

Stephen C. Hall

## NCRIPAL Contest

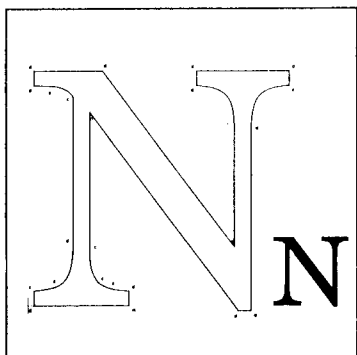
The National Center for Research to Improve Post-Secondary Teaching and Learning (NCRIPAL) is sponsoring an academic software contest funded by NeXT. Offering an award for excellence in academic software that focuses on research in core values of disciplines and makes them explicit, the group is requesting submissions from the university community.

Submissions may be based on any current technology, consist of one or several pieces of software, and may include design of templates as well. The deadline for preliminary applications is April 13. For further information and application forms, contact David Stein of the Harvard Office of Patents, Copyrights, and Licensing, Holyoke 449, or call him at 495-3067.



Zack Deal, responsible for OIT's new Xerox 4050 printer.





Methods of choice for producing hard-copy printouts in the individually-designed foreign language fonts depend on the particular software used to develop the fonts. Programs in PostScript files (like those for Apple products) can be used with the Apple

January 7: MacTechGroup meets the first  
Presentation of HFS by original Apple de  
School, Building E51, room 136. For in  
1. Linotronic Output

LaserWriter for good printouts. To obtain high-quality professional typesetting printouts, however, you will need to use either the Linotronic or a professional publisher, for even the Xerox 4050 produces printouts only as good as the LaserWriter (300 dots per inch). This newspaper is set on the LaserWriter; for an example of high quality typesetting, see inset 1, which shows Linotronic output.

While software already exists for Arabic language processing and for Chinese, anyone who regularly publishes in non-roman alphabets has great

В тех же случаях, где готовый перевод отступал от смысла еврейского текста или передавал

difficulty finding adequate word processing software. A Cyrillic font was developed at the William James facility using Altsys' Fontographer software (see inset 2), as were two Greek fonts--one for the Loeb Classical Library and one for public use, called

TitroffGreek (see inset 3). Almost finished is a Coptic font, with one in Hebrew still under development. For a description of the Nigerian font devel-

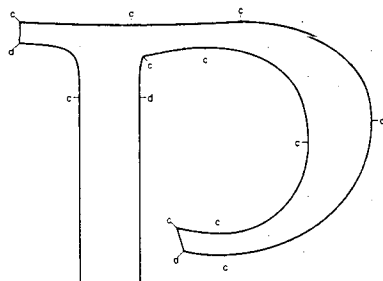
Ἦν μοι προθυμία καὶ ἔφεσις ἐκ  
πολλοῦ ἐμπειρίαν πραγμάτων καὶ  
γνώσιν ταῖς τῶν σπουδαιοτέρων  
ἐμφυτεῦσαι διανοοίαις διὰ τοῦ

oped at Harvard, see the article elsewhere in *Window*.

People who publish in foreign languages sometimes encounter problems that cannot be solved by designing non-roman characters; there are also technical problems relating to direction and combination in some languages. Semitic languages are written from right to left, and Chinese and Japanese are either right-left vertically oriented or left-right horizontally. FeiMa, a Chinese word processing program has been developed by Gene Wu for the Mac, and for simple Japanese, Japanese Language Services has EgWord.

For mathematical and scientific typesetting requiring special symbols or super- and subscripts, Donald Knuth designed TeX, a public domain software package. Newer, commercial versions of the software are presently being developed and will soon be marketed by Addison-Wesley.

Illustrating how curved and straight elements are put together in PostScript



font design is a section from the letter "P" shown in inset 4. Each small letter indicates the point at which a curve begins or ends. Curves can be modified as desired to obtain particular shapes.

For information about using the special fonts available at William James, contact Scott Bradner at 495-3864. For information about designing fonts or adding special characters, Scott Bradner or Zack Deal, at 495-4793, are the best Harvard sources. Commercially, Adobe Systems in Palo Alto, CA, and Altsys in Texas have much experience in font design. (Information for this article was provided by Scott Bradner and Zack Deal.)

Recent meetings of the Medi-Mac users group featured presentations on *Pulse Point* and *FileMaker Plus*, practice management and professional billing software, as well as on recovering damaged files and disks. Medi-Mac, a group of health care professionals who use Macintosh equipment, has been meeting monthly at Boston's Beth Israel Hospital since March of 1986.

In February, a presentation by Ben Calica on networking Macintosh computers was the topic, and in March,

a demonstration of *MedQuest*, a computerized practice management system for physicians.

Meetings of the group are held on the third Thursday of each month, at 6-7:30 p.m. in the Dana 5 Conference Room of Beth Israel Hospital, 330 Brookline Avenue, Boston. To add your name to the group's mailing list, write to Medi-Mac, c/o the Boston Computer Society, One Center Plaza, Boston, MA 02108, or call Steven Locke at 735-4664 or Scott Finley at 277-3667.

Before introduction of Fontographer, to adapt existing fonts for use with the various Nigerian languages would have been almost as unwieldy as using existing printing systems. Unlike most other African languages, which are written in a mixture of Roman and non-roman letters, Nigerian languages expand the Roman alphabet with diacritics through a system originally developed by German missionaries in the region. Diacritic markings for Nigerian languages are of three types: a mark underneath vowels (see inset) and  $\underset{\cdot}{\text{z}}$  (called a "subdot" although often elongated), hooks at the tops of **b**, **d**, and **k**, and a set of three tone marks above all vowels and nasals. Some languages also need a special nasal symbol represented by an **n** with a superscript dot added. To incorporate the various writing systems, the extensive diacritic system requires 51 new combinations. Including upper-case letters and a currency symbol, there are 103 PanNigerian characters (see inset). Together with the 52 plain Roman letters, this system is satisfactory for transcribing all the larger languages and most of the smaller ones. Substitutions and changes for other languages are straightforward with the Mac system.

Apart from the hooked letters, most PanNigerian characters could be produced with overstrike (available on the new release of Microsoft Word), but because the vowels and nasals vary in width, each combination must be stored separately for optimal alignment of the subdot and tone marks. Alignment of tone marks is important because these markings should be read like a single line of a musical score. To keep the marks at a constant height with respect to lower-case letters requires that the height of upper-case characters also be reduced. Eliminating nonessential characters like cedilla-*c* allows all 103 characters to fit in the Macintosh ASCII set.

Creation of the PanNigerian font was made possible by an agreement between the Nigerian Federal Ministry of Education and the commercial firm

of Fundición Neufville of Barcelona. The font is based on Impressum, a Bauer letterpress face. Using a letterpress face promotes popularization of the new design because much Nigerian printing is done with metal type letterpress. The project itself involved a diverse group: linguists who advised the Nigerian Ministry of Education on the minimum number of characters required for Nigerian languages; Hermann Zapf, renowned typographer, who envisioned the design; Neufville director Wolfgang Hartmann, who donated the Impressum face; and Apple programmer Edward Oguejiofor, who adapted the ASCII table and programmed logical keystroke combinations.

While much work still remains before PanNigerian is ready for commercial typesetting, Macintosh applications are now possible. The current issue of the *Journal of the Linguistic Association of Nigeria* was

B b R r  
 m m n n á á ä ä æ æ ã ã  
 é é ê ê ë ë í í î î ¡ ¡ ï ï  
 ó ó ô ô õ õ ú ú û û ü ü ü ü  
 B b R r  
 M m N n Á á Ä ä Æ æ Æ æ  
 É é Ê ê Ë ë Í í Î î ¡ ¡ ï ï  
 Ó ó Ô ô Õ õ Ú ú Û û Ü ü Ü ü

PanNigerian characters (combinations stored as units).

edited on disk and typeset on OIT LaserWriters and the Chiron Linotronic 300 in William James Hall. (Copies of the journal are available from Victor Manfredi at 427 William James.) In addition, the Macintosh's capacity to store information in Nigerian orthographies permits the processing of language data for production of a new generation of dictionaries, a significant step in the growth of literacy.

Thanks to the linguists from the Nigerian Ministry of Education, Herman Zapf, Wolfgang Hartmann, Edward Oguejiofor, and the OIT and Chiron staff members who helped coax acceptable hard copy from the printers, Nigerians may soon find it easier to print publications in their own languages.

*Victor Manfredi*

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# Key map

Size: 36

Font: NbembRoman

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0 Undefined



Offset: 15  
(1) C-a  
Width: 760



Offset: 45  
(2) C-b  
Width: 521



Offset: 20  
L (3) C-c  
Width: 552



Offset: 6  
I (4) C-d  
Width: 240



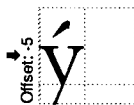
Offset: 44  
Š (5) C-e  
Width: 490



Offset: 30  
š (6) C-f  
Width: 302



Offset: 28  
Ý (7) C-g  
Width: 708



Offset: -5  
(8) C-h  
Width: 469



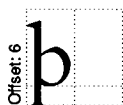
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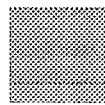
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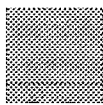
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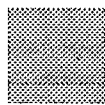
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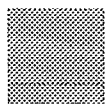
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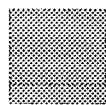
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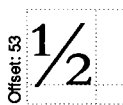
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19 Undefined



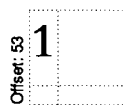
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Offset: 53  
(22) C-v  
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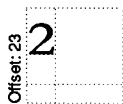
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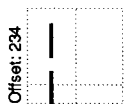
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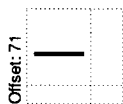
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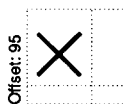
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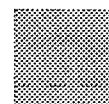
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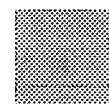
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(29) C-]  
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30 Undefined



31 Undefined



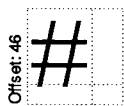
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Width: 260



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Width: 260



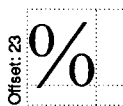
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Width: 406



Offset: 46  
# (35) #  
Width: 668



Offset: 26  
\$ (36) \$  
Width: 458



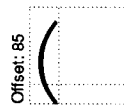
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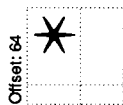
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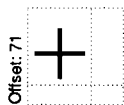
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Width: 302



Offset: 11  
) (41) )  
Width: 302



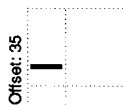
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Width: 554



Offset: 71  
+ (43) +  
Width: 667



Offset: 68  
, (44) ,  
Width: 260



Offset: 35  
- (45) -  
Width: 396



Offset: 39  
. (46) .  
Width: 181



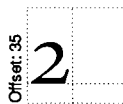
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Width: 534



Offset: 31  
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Width: 469



Offset: 107  
1 (49) 1  
Width: 469



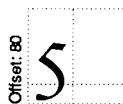
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2 (50) 2  
Width: 469



Offset: 65  
3 (51) 3  
Width: 469



Offset: 29  
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Width: 469



Offset: 80  
5 (53) 5  
Width: 469



Offset: 41  
6 (54) 6  
Width: 469



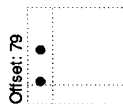
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Width: 469



Offset: 73  
8 (56) 8  
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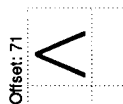
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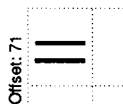
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: (58) :  
Width: 260



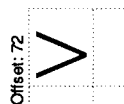
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Width: 260



Offset: 71  
< (60) <  
Width: 667



Offset: 71  
= (61) =  
Width: 667



Offset: 72  
> (62) >  
Width: 667



Offset: 51  
? (63) ?  
Width: 354

# Key map

Size: 36

Font: NbembRoman

Notice: Based on Bembo, altered serifs and descenders, w/ ligatures. Bembo is a trademark of The Monotype Corporation Plc.

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Offset: 47 @ (64) @ Width: 917	Offset: 4 A (65) A Width: 677	Offset: 0 B (66) B Width: 635	Offset: 52 C (67) C Width: 729	Offset: 15 D (68) D Width: 760	Offset: 3 E (69) E Width: 594	Offset: 43 F (70) F Width: 531	Offset: 57 G (71) G Width: 740
Offset: 30 H (72) H Width: 792	Offset: 45 I (73) I Width: 333	Offset: -109 J (74) J Width: 302	Offset: 19 K (75) K Width: 698	Offset: 20 L (76) L Width: 552	Offset: 13 M (77) M Width: 917	Offset: 30 N (78) N Width: 813	Offset: 53 O (79) O Width: 823
Offset: 20 P (80) P Width: 563	Offset: 53 Q (81) Q Width: 823	Offset: 16 R (82) R Width: 646	Offset: 44 S (83) S Width: 490	Offset: 32 T (84) T Width: 677	Offset: 18 U (85) U Width: 792	Offset: 4 V (86) V Width: 688	Offset: 1 W (87) W Width: 1000
Offset: 9 X (88) X Width: 750	Offset: 28 Y (89) Y Width: 708	Offset: 40 Z (90) Z Width: 677	Offset: 102 [ (91) [ Width: 302	Offset: 46 \ (92) \ Width: 458	Offset: 7 ] (93) ] Width: 302	Offset: 18 ^ (94) ^ Width: 469	Offset: -8 _ (95) _ Width: 500
Offset: 70 ' (96) ' Width: 333	Offset: 36 a (97) a Width: 396	Offset: 6 b (98) b Width: 500	Offset: 46 c (99) c Width: 427	Offset: 43 d (100) d Width: 500	Offset: 48 e (101) e Width: 438	Offset: 16 f (102) f Width: 271	Offset: 35 g (103) g Width: 469
Offset: 25 h (104) h Width: 521	Offset: 18 i (105) i Width: 260	Offset: -105 j (106) j Width: 250	Offset: 22 k (107) k Width: 500	Offset: 6 l (108) l Width: 240	Offset: 21 m (109) m Width: 792	Offset: 26 n (110) n Width: 521	Offset: 45 o (111) o Width: 521
Offset: 6 p (112) p Width: 500	Offset: 46 q (113) q Width: 500	Offset: 26 r (114) r Width: 333	Offset: 32 s (115) s Width: 302	Offset: 29 t (116) t Width: 292	Offset: 25 u (117) u Width: 521	Offset: 7 v (118) v Width: 479	Offset: 8 w (119) w Width: 740
Offset: 8 x (120) x Width: 490	Offset: -5 y (121) y Width: 469	Offset: 31 z (122) z Width: 406	Offset: 103 { (123) { Width: 479	Offset: 234   (124)   Width: 510	Offset: 104 } (125) } Width: 479	Offset: 7 ~ (126) ~ Width: 542	127 Undefined

# Key map

Size: 36

Font: NbembRoman

Notice: Based on Bembo, altered serifs and descenders, w/ ligatures. Bembo is a trademark of The Monotype Corporation Plc.

Printed by Fontographer 3.5 on Tue, May 12, 1992 8:34:24 PM

Offset: 4 Ä (128) OuA Width: 677	Offset: 4 Å (129) SOa Width: 677	Offset: 52 Ç (130) SOc Width: 729	Offset: 3 É (131) OeE Width: 594	Offset: 30 Ñ (132) OnN Width: 813	Offset: 53 Ö (133) OuO Width: 823	Offset: 18 Ü (134) OuU Width: 792	Offset: 36 á (135) Oea Width: 396
Offset: 36 à (136) O'a Width: 396	Offset: 36 â (137) Oia Width: 396	Offset: 36 ä (138) Oua Width: 396	Offset: 36 ã (139) Oia Width: 396	Offset: 36 å (140) Oa Width: 396	Offset: 46 ç (141) Oc Width: 427	Offset: 48 é (142) Oœ Width: 438	Offset: 48 ê (143) O'e Width: 438
Offset: 48 è (144) Oie Width: 438	Offset: 48 ë (145) Oue Width: 438	Offset: 18 í (146) Oei Width: 260	Offset: 18 ì (147) O'i Width: 260	Offset: 10 î (148) Oii Width: 260	Offset: -10 ï (149) Oui Width: 260	Offset: 26 ñ (150) Onn Width: 521	Offset: 45 ó (151) Oœo Width: 521
Offset: 45 ò (152) O'o Width: 521	Offset: 45 ô (153) Oio Width: 521	Offset: 45 ö (154) Ouo Width: 521	Offset: 45 õ (155) Ono Width: 521	Offset: 25 ú (156) Oœu Width: 521	Offset: 25 ù (157) O'u Width: 521	Offset: 25 û (158) Oiu Width: 521	Offset: 25 ü (159) Ouu Width: 521
Offset: 27 † (160) Ot Width: 500	Offset: 48 ° (161) SOB Width: 396	Offset: 46 ¢ (162) O4 Width: 427	Offset: 14 £ (163) O3 Width: 760	Offset: 52 § (164) O6 Width: 469	Offset: 80 • (165) O8 Width: 319	Offset: 7 ¶ (166) O7 Width: 448	Offset: 20 ß (167) Os Width: 521
Offset: 19 ® (168) Or Width: 802	Offset: 34 © (169) Og Width: 760	Offset: 15 ™ (170) O2 Width: 979	Offset: 70 ' (171) OeOe Width: 333	Offset: 26 " (172) OuOu Width: 333	173 Undefined	Offset: -52 Æ (174) SO' Width: 875	Offset: 54 Ø (175) SOo Width: 823
176 Undefined	Offset: 71 ± (177) SO= Width: 667	178 Undefined	179 Undefined	Offset: -106 ¥ (180) Oy Width: 500	Offset: 27 μ (181) Om Width: 500	182 Undefined	183 Undefined
Offset: 27 ƒ (184) SOp Width: 792	Offset: 23 ff (185) Op Width: 792	Offset: 13 ff (186) Ob Width: 552	Offset: 21 ª (187) O9 Width: 260	Offset: 26 º (188) O0 Width: 344	189 Undefined	Offset: 36 æ (190) O' Width: 625	Offset: 45 ø (191) Oo Width: 521

# Key map

Size: 36

Font: NbembRoman

Notice: Based on Bembo, altered serifs and descenders, w/ ligatures. Bembo is a trademark of The Monotype Corporation Plc.

Printed by Fontographer 3.5 on Tue, May 12, 1992 8:34:24 PM

Offset: 43 ¿ (192) SO/	Offset: 77 ¡ (193) O1	Offset: 71 ¬ (194) OI	195 Undefined	Offset: -112 f (196) Of	Offset: 10 f (197) Ox	198 Undefined	Offset: 34 « (199) O)
Offset: 44 » (200) SO)	Offset: 116 ... (201) O;	Offset: 0 (202) Obik	Offset: 4 À (203) O'A	Offset: 4 Ã (204) OnA	Offset: 53 Ö (205) OnO	Offset: 57 Œ (206) SOq	Offset: 46 œ (207) Oq
Offset: -6 - (208) O-	Offset: 150 — (209) SO-	Offset: 40 “ (210) O[	Offset: 41 ” (211) SO[	Offset: 40 ‘ (212) O]	Offset: 40 ’ (213) SO]	Offset: 71 ÷ (214) O/	215 Undefined
Offset: -5 ÿ (216) Ouy	Offset: 28 ÿ (217) SO'	Offset: -206 / (218) SO1	Offset: 105 ø (219) SO2	Offset: 34 < (220) SO3	Offset: 30 > (221) SO4	Offset: 18 fi (222) SO5	Offset: 16 fl (223) SO6
Offset: 37 ‡ (224) SO7	Offset: 79 · (225) SO9	Offset: 68 , (226) SO0	Offset: 68 , (227) SOw	Offset: 16 ‰ (228) SOe	Offset: 4 Â (229) SOr	Offset: 3 Ê (230) SOt	Offset: 4 Á (231) SOy
Offset: 3 Ë (232) SOu	Offset: 3 È (233) SOi	Offset: 45 Í (234) SOs	Offset: 45 Î (235) SOd	Offset: 26 Ï (236) SOf	Offset: 45 Ì (237) SOg	Offset: 53 Ó (238) SOh	Offset: 53 Ô (239) SOj
240 Undefined	Offset: 53 Ò (241) SOl	Offset: 18 Ú (242) SO;	Offset: 18 Û (243) SOz	Offset: 18 Ü (244) SOx	Offset: 18 ı (245) SOb	Offset: 46 ^ (246) SOh	Offset: 32 ~ (247) SOm
Offset: 29 " (248) SO,	Offset: 30 " (249) SO,	Offset: 123 " (250) Oh	Offset: 76 " (251) Ok	Offset: 102 " (252) "	Offset: -6 " (253) "	Offset: 72 " (254) "	Offset: 45 " (255) "

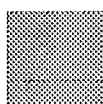
# Key map

Size: 36

Font: PanKwaPalatino-Roman.fog

Notice: Generated by Fontographer 3.3

Printed by Fontographer 3.5 on Sun, May 31, 1992 19:06:47



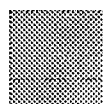
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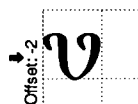
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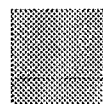
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4 (4) C-d



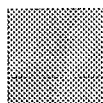
5 (5) C-e



6 Undefined



7 (7) C-g



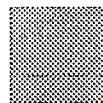
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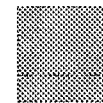
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11 Undefined



12 Undefined



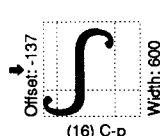
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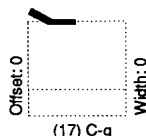
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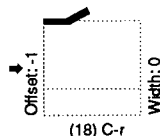
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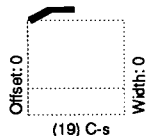
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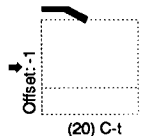
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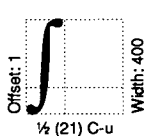
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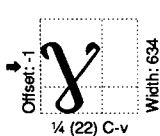
19 (19) C-s



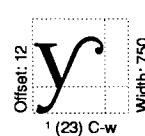
20 (20) C-t



21 (21) C-u



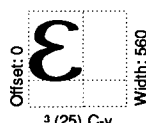
22 (22) C-v



23 (23) C-w



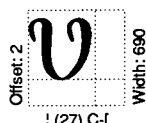
24 (24) C-x



25 (25) C-y



26 (26) C-z



27 (27) C-[



28 Undefined



29 Undefined



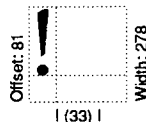
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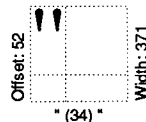
31 Undefined



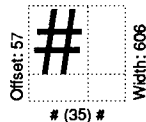
32



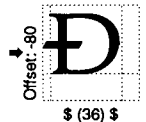
33 (33) !



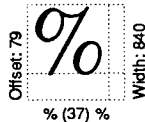
34 (34) "



35 (35) #



36 (36) \$



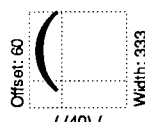
37 (37) %



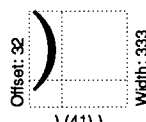
38 (38) &



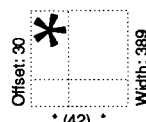
39 (39) '



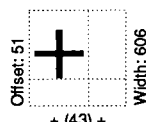
40 (40) (



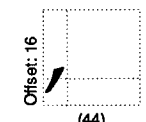
41 (41) )



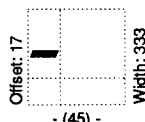
42 (42) \*



43 (43) +



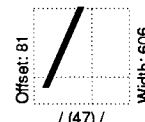
44 (44) ,



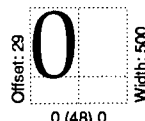
45 (45) -



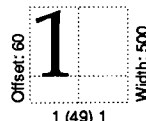
46 (46) .



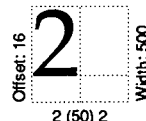
47 (47) /



48 (48) 0



49 (49) 1



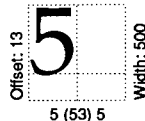
50 (50) 2



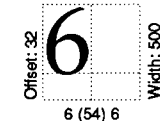
51 (51) 3



52 (52) 4



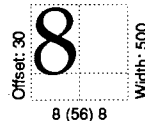
53 (53) 5



54 (54) 6



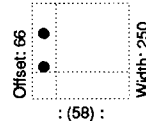
55 (55) 7



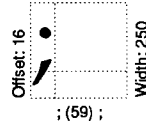
56 (56) 8



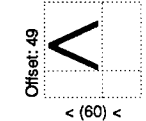
57 (57) 9



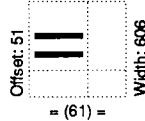
58 (58) :



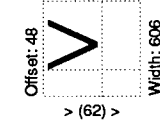
59 (59) ;



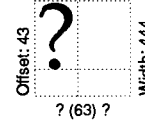
60 (60) <



61 (61) =



62 (62) >



63 (63) ?

# Key map

Size: 36

Font: PanKwaPalatino-Roman.fog

Notice: Generated by Fontographer 3.3

Printed by Fontographer 3.5 on Sun, May 31, 1992 19:06:47

Offset: 28 @ (64) @ Width: 747	Offset: 15 A (65) A Width: 778	Offset: 28 B (66) B Width: 611	Offset: 22 C (67) C Width: 709	Offset: 25 D (68) D Width: 774	Offset: 28 E (69) E Width: 611	Offset: 28 F (70) F Width: 556	Offset: 22 G (71) G Width: 763
Offset: 28 H (72) H Width: 832	Offset: 26 I (73) I Width: 337	Offset: -13 J (74) J Width: 333	Offset: 26 K (75) K Width: 726	Offset: 28 L (76) L Width: 611	Offset: 16 M (77) M Width: 946	Offset: 11 N (78) N Width: 831	Offset: 22 O (79) O Width: 786
Offset: 26 P (80) P Width: 604	Offset: 22 Q (81) Q Width: 786	Offset: 28 R (82) R Width: 668	Offset: 22 S (83) S Width: 525	Offset: 18 T (84) T Width: 613	Offset: 16 U (85) U Width: 778	Offset: 8 V (86) V Width: 722	Offset: 8 W (87) W Width: 1000
Offset: 14 X (88) X Width: 667	Offset: 9 Y (89) Y Width: 667	Offset: 15 Z (90) Z Width: 667	Offset: 82 [ (91) [ Width: 333	Offset: 81 \ (92) \ Width: 606	Offset: 47 ] (93) ] Width: 333	Offset: 89 ^ (94) ^ Width: 0	Offset: 0 _ (95) _ Width: 500
Offset: 109 ' (96) ' Width: 0	Offset: 30 a (97) a Width: 500	Offset: -2 b (98) b Width: 553	Offset: 32 c (99) c Width: 444	Offset: 32 d (100) d Width: 611	Offset: 32 e (101) e Width: 479	Offset: 23 f (102) f Width: 333	Offset: 32 g (103) g Width: 556
Offset: 23 h (104) h Width: 582	Offset: 23 i (105) i Width: 306	Offset: -14 j (106) j Width: 234	Offset: 23 k (107) k Width: 556	Offset: 23 l (108) l Width: 291	Offset: 23 m (109) m Width: 883	Offset: 23 n (110) n Width: 582	Offset: 32 o (111) o Width: 546
Offset: 23 p (112) p Width: 601	Offset: 32 q (113) q Width: 560	Offset: 23 r (114) r Width: 395	Offset: 33 s (115) s Width: 424	Offset: 24 t (116) t Width: 326	Offset: 15 u (117) u Width: 603	Offset: 16 v (118) v Width: 565	Offset: 16 w (119) w Width: 834
Offset: 20 x (120) x Width: 516	Offset: 12 y (121) y Width: 556	Offset: 16 z (122) z Width: 500	Offset: 58 { (123) { Width: 333	Offset: 270   (124)   Width: 606	Offset: 44 } (125) } Width: 333	Offset: 45 ~ (126) ~ Width: 606	127 Undefined

# Key map

Size: 36

Font: PanKwaPalatino-Roman.fog

Notice: Generated by Fontographer 3.3

Printed by Fontographer 3.5 on Sun, May 31, 1992 19:06:47

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Offset: 32 à (136) O'a Width: 480	Offset: 32 á (137) Oia Width: 480	Offset: 32 ā (138) Oua Width: 480	Offset: 32 â (139) Ona Width: 480	Offset: 32 ã (140) Oa Width: 480	Offset: 32 ä (141) Oc Width: 480	Offset: 32 å (142) Oee Width: 480	Offset: 32 ǻ (143) O'e Width: 480
Offset: 32 ê (144) Oie Width: 480	Offset: 32 é (145) Oue Width: 480	Offset: 32 è (146) Oei Width: 480	Offset: 32 ē (147) O'i Width: 480	Offset: 32 ê (148) Oii Width: 480	Offset: 8 ε (149) Oui Width: 400	Offset: 8 ẽ (150) Onn Width: 400	Offset: 30 í (151) Oeo Width: 330
Offset: 9 î (152) O'o Width: 330	Offset: -13 ï (153) Oio Width: 330	Offset: -21 ï (154) Ouo Width: 330	Offset: -1 ĩ (155) Ono Width: 330	Offset: 23 î (156) Oeu Width: 306	Offset: 30 ï (157) O'u Width: 330	Offset: 9 î (158) Oiu Width: 330	Offset: -13 ï (159) Ouu Width: 330
Offset: -21 † (160) Ot Width: 330	Offset: 32 ° (161) SOB Width: 318	Offset: -9 € (162) O4 Width: 330	Offset: 32 £ (163) O3 Width: 548	Offset: 32 § (164) O6 Width: 548	Offset: 32 • (165) O8 Width: 548	Offset: 32 ¶ (166) O7 Width: 548	Offset: 32 ß (167) Os Width: 548
Offset: 32 ® (168) Or Width: 548	Offset: 32 © (169) Og Width: 548	Offset: 32 ™ (170) O2 Width: 548	Offset: 32 ¹ (171) SOe Width: 548	Offset: 32 ² (172) SOu Width: 548	Offset: 31 ³ (173) O=	Offset: 31 ¼ (174) SO' Width: 444	Offset: 15 ½ (175) SOo Width: 604
Offset: 15 ¾ (176) O5 Width: 604	Offset: 15 ± (177) SO=	Offset: 15 ¾ (178) O, Width: 604	Offset: 15 ¾ (179) O, Width: 604	Offset: 15 ¾ (180) Oy Width: 604	Offset: 15 ¾ (181) Om Width: 604	Offset: 15 ¾ (182) Od Width: 604	Offset: 15 ¾ (183) Ow Width: 604
Offset: 15 ¾ (184) SOp Width: 604	Offset: 31 ¾ (185) Op Width: 632	Offset: 31 ¾ (186) Ob Width: 632	Offset: 23 ¾ (187) Og Width: 886	Offset: 23 ¾ (188) O0 Width: 886	Offset: 23 ¾ (189) Oz Width: 886	Offset: 23 ¾ (190) O' Width: 584	Offset: 23 ¾ (191) Oo Width: 584



# Key map

Size: 36

Font: PanKwaPalatino-Roman.fog

Notice: Generated by Fontographer 3.3

Printed by Fontographer 3.5 on Sun, May 31, 1992 19:06:47

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Offset: 23 k (200) SO/	Offset: 33 s (201) O;	Offset: 0 (202) Obik	Offset: 15 Á (203) O'A	Offset: 15 À (204) OnA	Offset: 15 Ā (205) OnO	Offset: 26 Ē (206) SOq	Offset: 26 ē (207) Oq
Offset: 26 è (208) O-	Offset: 26 ē (209) SO-	Offset: 26 é (210) O{	Offset: 26 è (211) SO{	Offset: 26 ē (212) O}	Offset: 26 ē (213) SO}	Offset: 26 é (214) O/	Offset: 26 ē (215) SOv
Offset: 26 ē (216) Ouy	Offset: 26 ī (217) OuY	Offset: 26 ī (218) SOI	Offset: 13 ī (219) SO2	Offset: 26 ī (220) SO3	Offset: 26 ī (221) SO4	Offset: 26 ī (222) SO5	Offset: 13 ī (223) SO6
Offset: 22 ó (224) SO7	Offset: 22 ò (225) SO9	Offset: 22 ō (226) SO0	Offset: 22 ō (227) SOw	Offset: 22 ó (228) SOr	Offset: 22 ò (229) SOm	Offset: 22 ō (230) OIE	Offset: 16 ú (231) SOy
Offset: 16 ù (232) OUE	Offset: 16 ū (233) O'E	Offset: 16 ū (234) SOs	Offset: 16 ú (235) SOd	Offset: 16 ù (236) SOi	Offset: 16 ū (237) O'I	Offset: 16 m (238) SOh	Offset: 16 m (239) SOj
Offset: 16 m (240) SOk	Offset: 11 n (241) SOI	Offset: 11 n (242) SO;	Offset: 11 n (243) OIU	Offset: 11 n (244) O'U	Offset: -201 b (245) SOb	Offset: -201 d (246) SOi	Offset: 26 k (247) SOn
Offset: 22 s (248) SO,	Offset: 120 s (249) SO,	Offset: 99 s (250) Oh	Offset: 117 s (251) Ok	Offset: 89 s (252) SOz	Offset: 107 s (253) SOg	Offset: 221 s (254) SOx	Offset: 207 s (255) SOt