1   BACKGROUND and DESIGN

1.1   It is not yet fully appreciated that the typewriter keyboard designed over 100 years ago, has a physical layout determined by the original machine construction and a letter layout carefully arranged to slow down operators to minimise the type bar clashes caused by its mechanical limitations.   Although the need for this has long since passed, the overall investment in training and equipment has so far been sufficient to prevent the wide adoption of any alternative.

1.2   The arrival of electronics now provides a fresh opportunity to start again, not only to revise the letter layout, but also to develop a new shape so that the stresses imposed on the operator by the present design are eliminated.   The surprising extent of this stress is detailed in the paper by D.Fergusson and Joan Duncan published in Ergonomics Nov. 1974.   The clinical effects described show that the real costs of continuing to use the typewriter keyboard can no longer be assessed only in cash, but must include a measure of physical suffering and occupational hazard.

1.3   The MALTRON ergonomic keyboard developed by Lillian Malt and myself has resulted from a careful study of the way hands work, the positions in which they are comfortable (free of stress) and the sequences of finger movement that can be made quickly.   Based on the results of a massive computer analysis of the use of over a million words of text, a new letter layout now has 90% of the letters of the 100 most used words (47% of text) on the home row against 52% for Qwerty.

1.4   The new shape divides the keys into two scooped out groups for the fingers and two separate groups of up to 9 keys for each thumb.   The two finger groups are 5 inches apart and this ensures that the wrists are straight.   The central area is easily reached by the index fingers, so that word processing or computer function keys are much more easily and quickly used than on present designs.

2   PERFORMANCE

2.1   Tests by Mrs.W.M.Heath with secretarial students at Basingstoke Technical College have shown the learning time for the MALTRON to be about a quarter of the usual period and the typing position 'very comfortable'.   Many operators have now confirmed that there is no loss of Qwerty skill through learning MALTRON, and it is evident that the process is similar to learning another language or another musical instrument. Although a new idea to the Office, there is no reason why 'Keyboarders' should not acquire two skills.

2.2   Those who are already using the Qwerty keyboard may not have time, or see any point in learning again, and indeed may find the initial frustration of reduced output unacceptable. Although their final performance will not be as high as potentially possible with the full MALTRON, their needs can now be met by fitting keyboards with larger memories and a Maltron/Qwerty changeover key. This new feature means that only a few hours of adaption practice are needed to regain former speed and enjoy the ease and comfort of the new shape.

2.3   Recent results have shown that the accurate tactile finger position information the operator receives from the shaped rows of keys, combined with the new letter layout, can reduce errors to about a tenth of the normal rate.   A change of this magnitude indicates that matching at the man/machine interface has been greatly improved, job satisfaction increased and at least some of the design targets achieved.

3   ENLARGED REPERTOIRES

3.1   A further important advance offered by the MALTRON keyboard relates to the repertoires of graphic characters and of control functions that may be keyed.   Because the physical shape suits the movements of the fingers better, it is practical to provide about 70 keys that are easily reached, instead of the 55 on conventional typewriter keyboards.

3.2   This may be very relevant to recent developments in processor-based office equipment for the preparation of text of all kinds, and for its interchange by automated means; this comes under the collective term 'text communication' or, more specifically the Teletex and videotex services.   A study of users' requirements has established that it is advantageous to

3.3   The MALTRON keyboard is uniquely suited for this type of application. Layouts have been worked out optimised for general office use, for the telex service, and for the new Teletex service.

4   ADVANTAGES for the DISABLED

4.1   Although developed for normal office work the ease of learning and use makes the MALTRON keyboard particularly helpful to those who are disabled. When coupled to a separate printer such as the Olympia RO the combination becomes a 'Typewriter' with a loose keyboard. The RO machine is particularly good in this application, as all its functions including insertion and removal of paper can be carried out from the keyboard. For types of disability where the operator is confined to bed or a wheelchair, the keyboard can now be positioned for greatest ease of use, while the printer is placed on an adjacent table or trolley.

4.2   The accurate tactile information from the keyboard is particularly helpful to those who are blind. Mr. L. Douch, a computer systems consultant, who became blind some three years ago, concluded his trial report with the comment 'The keyboard is a joy to use, - comfortable, fast, and giving a confidence and sureness of touch, which is only fully appreciated after some use.'

4.3   For those who have lost the use of one hand a SINGLE HANDED keyboard has been designed, which is half the full unit but with extra thumb keys. Numbers and symbols are provided on a third shift, and we believe that a good operator should be able to achieve an output up to 40% more than could be attained on a standard keyboard. It is plug compatible with the full size unit and provides the complete ASCII code set, to operate micro-computers, as well as the printer. This keyboard could also be used for single handed data entry for computer terminals. A left hand version has recently been supplied for experimental use in Postal code packet sorting.

4.4   A special keyboard has been made for a small boy (6) suffering from the effects of Arthrogryposis (causing improperly formed hands so that he can not write). In his case to reduce hand movement as much as possible, the keyboard has only three rows of keys like some early typewriters, but it has a third shift to place the numbers on the more easily accessible home row when needed. Bars on the top take the weight of Robert's hands and guide his fingers.

4.5   The most recent development is a HEAD or MOUTH stick keyboard also designed to operate the Olympia printer and give full operating facilities. The keyboard is mounted on an articulated arm so that it can be used at seated mouth height by an operator in a wheelchair. The arm can be released to swivel, and this allows the trolley mounted assembly to be easily moved from room to room.

5   CONCLUSION

5.1   In developing the MALTRON we believe that keyboards, as the means of fast, accurate, text and data entry will be with us for many years to come, and that it is no longer reasonable for operators to be subjected to the constraints, stress and fatigue imposed by the design of a century ago. We feel that the results now justify a strong push forward to establish a new International keyboard to improve the performance and working conditions of operators, and meet the growing need for multi-lingual communication.

5.2   Special keyboards help in overcoming several of the communication problems experienced by the Disabled, and potentially, to allow at least some to attain an operating skill sufficient for full commercial employment, which would not be attainable otherwise.

6   ACKNOWLEDGEMENTS

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