

## News

The following report was received from Prof. Ichiro Honda of the Department of Psychology at Kyoto University in Kyoto, Japan. The translation has been authorized by staff members of the Institute of which Prof. Honda is a member.

Since finishing electronic computers ETL-Mark III and IV last fall, we have been working on the English-to-Japanese electronic translator and reader for English, and we have just completed pilot models of both machines. With these machines, sentences typewritten in English are automatically translated into Japanese.

The machine is instructed to translate English into Japanese in the following manner.

1. For each English sentence, one Japanese sentence is processed. (Sentence-for-sentence translation.)

2. After each word of a sentence has been identified in the dictionary, a decision is made about the part of speech of the word.

3. Suffixes such as -s denoting plural and -ed denoting past are handled according to suffix-processing orders.

4. We do not work out a corresponding Japanese word directly from an English word, considering required rearrangement of word order.

5. Because there are four kinds of sentences, declarative, interrogative, exclamatory, and imperative and because there are many types of declarative sentences, sentence types and sentence patterns must be identified. This process is called "classification of sentence patterns."

6. To identify the sentence pattern, the subject, verb, object and complements must be sorted out. The logical process is carried on until the fundamental structure of the sentence conforms to any one of the following five fundamental sentence patterns, setting aside modifiers consisting of unneeded words and phrases such as the adjective preceding the noun and the prepositional phrase following the noun.

I. S-ga V-suru.  
Kare-ga Benkyo-suru.  
(He studies.)

H. S-ga V-da C.  
Kare-ga da Gakusei.  
(He is a student.)

III. S-ga Vt-suru O-o.  
Kare-ga Ai-suru Musume-o.  
(He loves a girl.)

IV. S-ga Vt-suru IO-ni DO-o.  
Kare-ga Hasso-suru Ototo-ni Kozutsumi-o.  
(He sends a parcel to the brother.)

V. S-ga Vt-suru O-o C-ni.  
Karera-ga Senkyo-suru Kare-o  
Shicho-ni.  
(They vote him major.)

7. When it happens that there is more than one part of speech for a word, the first part of

- speech is tested. If the pattern of the sentence cannot be identified, we proceed to the second. There is only one corresponding Japanese word for each part of the English word. For example, kono for 'this' (adj.) and kore for 'this' (pro.).
8. After the pattern has been identified, ga. is added to the subject, -o to the object, and -ni to the complement; the verb is moved to the end of the sentence; and a roughly corresponding Japanese sentence is constructed.
  9. The "near sentence" mentioned above is supplemented with pre-excluded modifiers and all words of the original English sentence are inserted. In prepositional phrases the noun is placed before the preposition.
  10. Each English word is replaced by the corresponding inflected Japanese word.
  11. The Japanese sentence is written entirely in 'Katakana' and a space is left between words as in the English sentence, except the 'Kakujoshis' of -ga, -ni, and -o.
  12. A word not stored in the memory is processed as a noun and typewritten just as it was in English.
  13. Because 'Kanji' is not used, 'On' phonetic reading is limited to a minimum in the Japanese sentence produced, and 'Yamato-Koto-ba' (traditional Japanese not derived from Chinese) is preferred, for example, saiwai for kofuku and sare for kanojo.
  14. For the time being, sentences containing a

relative pronoun are not handled in our program,

#### Outline of the Apparatus.

1. Input: It reads 73 letters, including the capitals, lower case letters, comma, question mark, etc.. A letter consists of 8 bits (units).
2. Output: 75 letters of 'kana' (dakuten, handakuten, and soukon), and the capitals of the Roman alphabet, etc. 8 bits per letter.
3. Letters inside the apparatus: After being referred to the "dictionary" all letters are represented by word numbers, thereby avoiding inconvenient processing of English words of varying lengths such as very short ones (I, is) and much longer ones (dictionary, representative, etc.). This representation is used until just before the Japanese translation.
4. Memory: We installed *a*. magnetic drum containing 820, 000 bits of information on English grammar, parts of speech, idioms, translation of each word, Japanese grammar, etc. . The information is arranged in 200 columns. Besides these 200 columns, there are 10 extra columns for the various translation operations, and each word can be processed at the speed of 1ms.
5. Outline of the main apparatus (translator): It looks very much like the electronic computer and consists of about 650 packaged circuits patterned after the ETL-Mark IV electronic computer. There are 46 orders for the operations inside the machine.