that "The late Lord Panmure, knowing the low state of my finances, offered to be at the expenses of the patent if I would accept one. For the reasons above stated, I declined his lordship's offer". In later life, Bell admitted that it was probably a mistake that he did not patent his invention. As he gave it freely to the public, many imitations were turned out. He himself says, "Had I patented the machine at the time, all this bungling in machine-making would have been avoided; and the issue perhaps proves that, for the public benefit even, this was the prudent course to have been adopted".

Bell's machine embodied all the main features of the modern reaping machine though in a somewhat crude form. All these features were also included in the earliest known machines which could be ascribed to McCormick, but before McCormick's machines were made several of Bell's machines were already in America. McCormick's patents were disputed in his own country and prolonged law suits took place with regard to them.

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Gesture Language

A PARAGRAPH in the Research Items in NATURE of December 5, entitled "Origins of Speech and the Orang-Utan", refers to Dr. Cornelius J. Connolly's important studies of the brains of various primates. The note stated that it is believed by neurologists that the associative process, with the power of making articulate sounds, constitute the essential elements in human speech, and that the association between sound and objects makes symbolism possible.

May I point out that human power of symbolism is not primarily dependent on association between *sound* and objects, but rather on the ability (which apparently is peculiar to man) of analysing events—whether sensed or imagined—and expressing the separated elements by a series of separate bodily gestures.

The association between sound and objects (except in the comparatively rare onomatopœic symbolism of objects or events which are naturally associated with a characteristic and imitatable sound) came later; it probably arose—as I have previously pointed out—from the natural sympathy of movement between man's hands and his mouth which Charles Darwin described in "The Expression of the Emotions".

It is not generally known that the natural pantomime of uneducated deaf mutes, by which the born deaf of all nations can communicate with one another, is not built up of separate signs equivalent to words. It does not analyse events into separate parts equivalent to parts of speech; it cannot define. It would appear that man's advance was primarily due to his development of this power of symbolism —which made new syntheses possible.

The original pantomimic expression of primitive man was doubtless accompanied by an emotional gabble—due to the Darwinian association of hand and mouth, and to the corresponding association of facial gesture and muscular movements of the larynx and pharynx which was assumed by E. B. Tylor[1] and which I have personally observed.

This 'gabble' can scarcely have been understandable by ear, for if the hand gestures were not standardized, the associated sounds could have no constant meaning. It was only when man had learnt to use a particular gesture to symbolize a definite object, action, quality, etc., that true speech began.

The chimpanzee fails in two respects: he cannot apparently symbolize, and his tongue does not move in sympathy with his hands. Thus, Madame Kohts[2] points out that whereas the young child feels with his hands and his tongue, the young chimpanzee feels with his hands and his lips.

In attempting to locate the areas of the brain responsible for the development of speech, the physical anthropologist should, I suggest, study especially those areas which control bodily gesture on one hand, and those which give the power of analysis on the other.

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[1] E. B. Tylor, "Primitive Culture", vol. 1, chap. v.
[2] "Infant Ape and Human Child", Darwinianum, Moscow, 1935.

Neutrino Theory of Light

PROF. V. FOCK[1] has pointed out an apparent inconsistency in the neutrino theory of light. He shows that the operator of Jordan

$$\sqrt{|\nu|}\,b(\nu) = \sum_{\alpha=-\infty}^{\alpha=+\infty} \gamma^{+}(\alpha)\gamma(\alpha+\nu) \qquad (1)$$

commutes with his adjoint operator $b^{+}(\nu) = b(-\nu)$, while according to Jordan the relation

$$b^{+}(\nu)b(\nu) - b(\nu)b^{+}(\nu) = -1 \text{ for } \nu > 0 \qquad (2)$$

should hold. In configuration space the operator takes the form $\sqrt{|\nu|}\,b(\nu) = \sum_{k=1}^{k=n} b(\nu,x_k)$. k denotes the co-ordinate of the kth particle. Fock identifies the operators $b(\nu,x^k)$ with $e^{i\nu xk}$. Therefore all the $b(\nu)$ and $b^{+}(\nu)$ commute in contradiction with (2). However, a configuration space representation of a problem is only possible *if the number of neutrinos n is finite.* As we need the interpretation of Dirac with respect to the filled up negative energy states ($\alpha < 0$), we are concerned with an *infinite number of particles.*

If we assume *the number of possible states finite*, a configuration space description of $b(\nu)$ is possible, because the number of neutrinos is *a fortiori* finite. Let therefore $u_a(x)$ be the wave function of a state α. α takes all integral values between $-A$ and $+A$, where A is a finite positive integer, which tends towards infinity. The operator $b(\nu,x_k) = b^{+}(-\nu,x_k)$ is defined by

$$b(\nu,x_k)u_a(x_k) = \begin{cases} u_{a-\nu}(x_k), \text{ if } -A \leqslant \alpha - \nu \leqslant A \\ 0\ , \text{ for all other values of } \alpha - \nu \end{cases} \qquad (3)$$

Let

$$\psi(\alpha_1, \ldots \alpha_k \ldots) = \sum_P \delta(P)u_{a_1}(x_1)u_{a_2}(x_2) \ldots u_{a_k}(x_k) \ldots u_{a_n}(x_n),$$

with $\delta(P) = \pm 1$ an antisymmetric wave function. The sum is to be extended over all permutations P. An easy calculation leads to the identity

$$\nu\{b^{+}(\nu)b(\nu) - b(\nu)b^{+}(\nu)\}\psi = \psi\left\{\sum_{a=A-(\nu-1)}^{a=A} N_a - \sum_{a=-A}^{a=(\nu-1)-A} N_a\right\} \text{ for } \nu > 0 \qquad (4)$$

$N_a = 1$ or 0 according to whether the particular α occurs or does not occur in $\psi(\alpha_1 \ldots \alpha_n)$. If the number