whether the algal cell could use GSH or GSSG as a nitrogen source, all nitrate except these two peptides was eliminated from the media. Both GSH and GSSG acted as sources of nitrogen, although it is uncertain whether the intact molecule or the amino-acid constituents of the molecule entered the cell. I was interested in glutathione because Peel[4] showed that the small peptide can be maintained non-enzymatically in an oxidized state by using B_{12}. Another suggestion is that glutathione acts as a "poising" agent in cellular oxidation-reduction reactions[5].

As Fig. 3 shows, GSSG and GSSG with B_{12}, as well as B_{12} alone, prevented palmella formation. The presence of GSSG in the medium enhanced the effect of B_{12} in preventing the aggregation of cells, although GSSG by itself was much less effective than the vitamin in preventing palmella formation, possibly because GSSG is readily reduced to GSH. Whether GSSG and B_{12} prevent palmella formation in this organism through the maintenance of a surface protein or proteins in an oxidized state or by means of an intracellular mechanism remains to be seen.

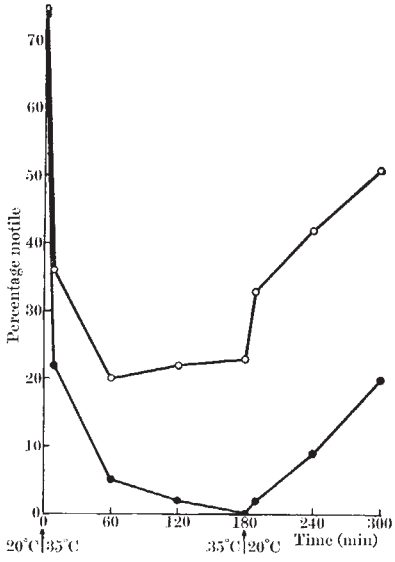

Fig. 1. Effect of vitamin B_{12} on motility in *N. pseudoalveolaris* under biothermal stress. ○, With B_{12}; ●, without B_{12}.

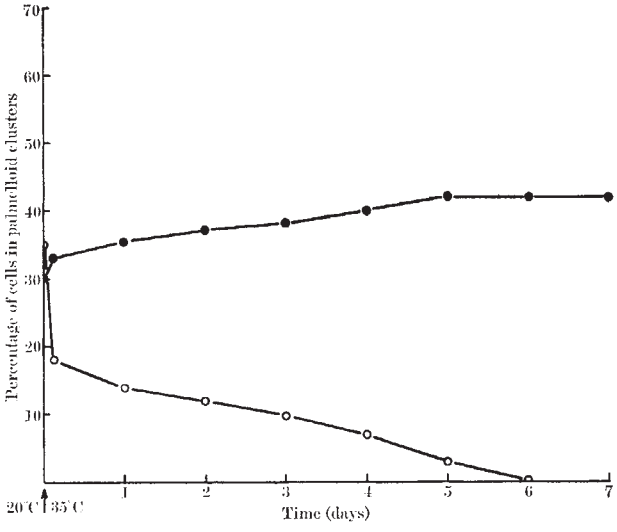

Fig. 2. Effect of vitamin B_{12} on palmella formation in *N. pseudoalveolaris* under biothermal stress. ○, With B_{12}; ●, without B_{12}.

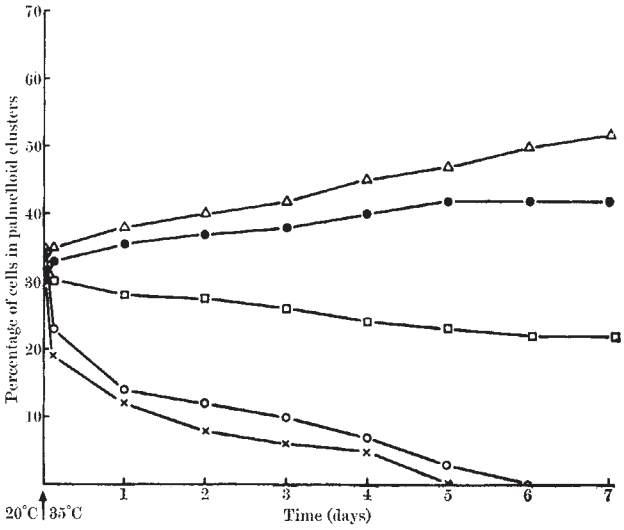

Fig. 3. Effect of vitamin B_{12}, GSSG and GSH on palmella formation under biothermal stress. ○, With B_{12}; ●, without B_{12}; □, GSSG; △, GSH; ×, with B_{12} and GSSG.

Motility of the organism, on the other hand, was not effected by GSSG or GSH $\pm$ B_{12}, indicating that B_{12} influences motility by *modi operandii* other than that shown to be involved in palmella formation. Prevention of loss of motility under biothermal stress by B_{12} may be related to the vitamin's property of stimulating protein methylation, which has also been implicated in the synthesis of chloroplast protein in *N. pseudoalveolaris*[3]. In this context it should be said that ε-N-methyl lysine has been reported to be a component of flagellin[6]; moreover, a contractile ATPase system has been shown to control the structure of chloroplasts[7].

These observations support the notion that B_{12} participates in cellular homeostatic mechanisms by diverse biochemical roles.

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ELIZA WALLER EASLEY

Rockefeller University,
New York.

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GENERAL

ESP: Deficiencies of Experimental Method

J. G. PRATT *et al.*[1] recently reported that a subject, Pavel Stepanek, was able to demonstrate extra-sensory perception (ESP) by making a particular verbal response to a concealed object in conditions where, according to a referee's report, "this object could not have been recognized by the use of any known sensory mechanism".

It appears that before 1965 Stepanek was able to allocate envelopes (referred to as covers) into two

categories according to which side of cards (one side green, the other white) was uppermost inside the envelopes. In 1965, after warping of the cards towards the green or white side had been suggested as affording a sensory cue, Stepanek lost the ability to make this type of discrimination.

It is now reported that since 1967 Stepanek has displayed a new extra-sensory ability. He now tends to call "white" to a particular cover (No. 15/16) irrespective of whether the card contained in it has its green or white side uppermost. They list a series of eighteen experiments, in fifteen of which the covers were placed inside further envelopes (referred to as jackets), and in which various precautions were introduced as the series proceeded to prevent Stepanek using sensory cues.

A satisfactory demonstration of ESP would obviously require the total elimination of all normal sensory information. But in the experiments described Stepanek could have received information through at least three sensory modalities, tactile, visual and olfactory.

In all eighteen experiments Stepanek not only touched but handled the jackets containing the covers. Pratt and colleagues do not report—although another investigator reports it elsewhere[2]—that Stepanek was unsuccessful when the objects he was attempting to identify were placed inside rigid boxes rather than envelopes.

Stepanek had full view of the covers or jackets. No tests are reported in which he was blindfolded or screened both from the material he was handling and from the experimenter. It was obviously possible to identify a particular jacket because the experimenter had to do so to complete his records. In fact it would be difficult to construct jackets from sheets of manilla card stapled together on three sides that could not be distinguished from each other.

The open sides of the jackets are reported to have been turned away from Stepanek so that he could not see the covers inside them. But the results of an investigation[3] carried out by S. G. Soal on a music hall artiste named Fred Marion would have been well known to Pratt. It is clear from Soal's findings that when an experimenter is present with a subject, the same precaution must be taken against the experimenter having any information about the targets as against the subject's doing so. It is strange that Stepanek's score should have dropped to chance level in series 14 when the fourth side of the jackets was stapled to exclude the possibility of his "glimpsing an edge or corner of the enclosed cover", because this fourth side was facing away from him. But while it is difficult to see how the addition of a few staples should have played havoc with Stepanek's extra-sensory powers, they could have prevented the experimenter from seeing inside the jackets and, voluntarily or involuntarily, transmitting information to Stepanek.

Olfactory cues were completely disregarded.

In the course of the series of eighteen experiments, various safeguards were introduced and other changes were made in the experimental conditions. Stepanek's scoring rate tended to fall throughout the series of experiments. A large improvement occurred, however, during series six, after the number of covers (and jackets) was reduced from ten to eight, and again during series eight after the number was further reduced to four. Thus Stepanek's ability to call "white" to cover fifteen/sixteen appears to have been dependent on the number of other covers used in the test. But if a subject has information, sensory or extra-sensory, from a particular target we should not expect his scoring rate on that target to be dependent on the number of other targets used in a test. If, on the other hand, a subject is attempting to distinguish a particular target among a set of other targets his ability might be expected to be dependent on the number of other targets involved.

It is not clear from the report whether a precaution, once introduced, was retained in all later experiments. In the last eleven experiments four jackets were used of which one contained the salient cover fifteen/sixteen. These four jackets were placed in a pile before Stepanek, who went through the pile making his decisions. The run of four trials was usually repeated 100 times during an experiment. In experiment fourteen, when staples were inserted into the fourth side of the jacket, these presumably had to be removed and reinserted after each run of four trials, that is 100 times. Stepanek was unsuccessful in this experiment and it can be assumed from the report that the precaution of stapling the fourth side of the jackets was retained for the remaining four experiments. If this were so the staples would have had to be removed and reinserted a further 300 times. If, however, the precaution of changing the covers inside the jackets before each run of four trials was not retained in these later tests, the statistical evaluation of the results is affected, because merely by calling "white" to a particular jacket each time it appeared a subject would have a one in four chance of 100 per cent success. On the other hand, if the precaution of stapling the fourth side of the jackets was not retained after experiment fourteen, it would appear that Stepanek was successful provided it was possible for him or anyone present to glimpse "an edge or corner of the enclosed covers".

The investigators state that the results listed in their table are not the result of a "post-hoc" selection of favourable instances because the combined results of all the work carried out in the period are overwhelmingly significant ($P < 10^{-50}$). But because the overall probability for the results published in their table is much smaller than this last figure, it would appear that other less successful experiments than those listed in their table were carried out. It is, in fact, hard to believe that the investigators at no time asked themselves whether Stepanek's ESP powers depended on his handling the materials. No experiment is reported, however, in which he was kept out of contact with the jackets. Did such an experiment ever take place, or did Stepanek refuse to perform in such conditions? Again, rather than making flimsy jackets which opened and which in some of the experiments had to be restapled after each run of four guesses, it would have been a simple matter to have placed the covers inside boxes with lids that could be easily removed. Such boxes would have eliminated tactile cues and would also have prevented the subject or the experimenter glimpsing any edges or corners of the covers. But again, if tests were conducted in this manner, they have been omitted from the report.

It has been emphasized that in investigations of this nature, where extraordinary powers are claimed for a particular individual, the findings should be confirmed by independent investigators; furthermore, confirmation should be obtained before a result is reported because these high-scoring subjects invariably lose their alleged ESP powers when the experimental report describing their feats is published[4].

In the present case one investigator (J. G. P.) was present during all the experiments. Four of the signatories to the report were present on a single occasion, and a fifth was present on two occasions. At no time was a complete change of personnel attempted even in the puerile conditions in which Stepanek was being tested.

C. E. M. HANSEL

Department of Psychology,
University College of Swansea,
Swansea,
Glamorganshire.

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