Verbal arithmetical problems with missing, or surplus, or contradictory data (called shortly MSCD problems) are considered as a possible means of teaching mathematics in the primary school. The problems are considered here in the logico-mathematical setup, that is, the solvers are told that they can use only the data and the information given in the problem formulation. The paper consists of three parts. The first part is concerned with a categorization of MSCD problems while the two other parts are reports on two independent, exploratory studies. In one of them, subjects were interviewed individually and given the same set of MSCD problems. In the second, MSCD problems were used during regular classroom lessons and various observations were gathered.

Introduction. In recent years some authors (Kilpatrick and Radatz 1983, Radatz 1984, Markovits, Hershkowitz and Bruckheimer 1984, Semadeni 1986, 1987) pointed out the possible didactical significance of certain nontraditional verbal arithmetical problems, specifically:

(m) problems with missing data or, more generally, problems with not enough information to answer the question;

(s) problems with surplus (or superfluous) data, that is either irrelevant or redundant;

(c) problems with contradictory (inconsistent) data, or more generally, with impossible (logically or physically) data.

These three types of problems, though logically different, have a significant common feature: in order to recognize and explain the problem, the student has to read the text critically, think meaningfully and not follow routine techniques.

Teachers may pose such problems to their pupils as a means of instruction: rather than making computations to find the solution, children should think whether the
problem is solvable and, if so, whether all the data are really needed. Thus the two main goals of using such problems are:

(a) To help children learn to solve ordinary verbal problems and to apply this knowledge in real-life situations.

(b) To help children develop the habit of reading texts of problems meaningfully and critically.

The paper focusses on the content of problems as a variable. The problems are grouped according to their semantic structure. Various examples of problems of types (m), (s), (c) are given. However, upon closer examination, it turns out that types (m), (s), (c) can be further refined. The aim of this paper is:

1° to propose a categorization of certain problems with missing, surplus or contradictory data (such a categorization may help the teacher or the author of a textbook to select suitable problems);

2° to report on an investigation of how children spontaneously recognize the solvability or unsolvability of problems with missing, surplus or contradictory data;

3° to report on observation of childrens' reactions to such problems during regular classroom lessons.

Background.

Several studies concerned problems with surplus (extraneous) data: Krutecki 1968, Bechtold 1965, Nesher 1976, Zweng 1979, NCTM 1980, Bender 1985a (see also papers by Arter and Clinton 1974, Biegen 1972, Blankenship and Lovitt 1976, Fafard 1977; the references can be found in Suydam 1980). Some of these authors were concerned with other questions and only touched on the topic discussed here.

Few authors have studied problems with not enough data to answer the question: Krutecki 1968, Equipe Elementaire