there, and lived there, when asked to identify an elementary object on a photograph on the scale of say 1:2,000, often cannot identify this object? This refers particularly to agricultural items. Many military photo interpreters have found that they cannot successfully call upon the local population to identify such items.

DR. BLACK: I mean no offense to the great body of photo interpreters, but the problem is essentially one of generalizing and selecting the things that are typical of the area. If a person has no familiarity whatsoever with the area to begin with, he must do an awful lot of familiarizing through examining pictures, reading, looking at movies and so forth, thus getting his knowledge secondhand. If he has his knowledge firsthand to start with, he would have a head start on his interpretation work.

You said that persons familiar with an area through long residence couldn't identify an agricultural item on a large scale airphoto. Your question was answered in my paper which stated the individual must be "a discerning person."

QUESTION: I don't know why the speaker phrased the title of his paper the way he did. The title makes it seem that he is on the defensive. It sounds like he is trying to write-off the subject matter. I don't think that should be done. Subject matter keys complement and in many cases, supplement the regional key.

DR. ROSCOE: Dr. Black was asked if he would take that subject, with that title, based on the fact that he is a regional specialist. Later in the program subject

specialists will talk about the keys with which they are most familiar.

DR. BLACK: I don't think that I wrote off the subject keys at all. In fact the last recommendation in the paper is that the committee be organized in a dualistic fashion; that first of all there would be a series of subject keys for the entire study area for identification purposes. That would be one level of abstraction. Then in addition there would be a series of associative keys for distinctive regions. This is really a little higher level of abstraction. So I was not writing-off the subject key at all.

QUESTION: I am disturbed by and cannot understand your use of the word "generalization" in your title. A map is a generalization. The aerial photo is a reproduction of the landscape but is not the generalization of it. The key also should not be termed a generalization.

DR. BLACK: I disagree with you very greatly. An individual photograph, as you point out, is not a generalization. But you can't put all the photographs of an area into a key. There would be no point in having the key if it included complete photo coverage. It would be so unwieldly that it would be unuseable. One has to select typical photographs after making appropriate generalizations.

QUESTION: Don't you select the typical things rather than the generalized things?

DR. BLACK: I mentioned at the outset that there are a lot of semantic pitfalls in this title, and I see that this prediction or statement was true. One has to generalize in order to select and present the varying aspects of typical objects or conditions.

THE MECHANICAL ASPECT OF PHOTO INTERPRETATION KEYS*

Hank Weiner, Photographic Interpretation Center

IT HAS long been realized among photo interpreters that a mechanical P.I. Key would be of great advantage in expediting photo interpretation requirements for rapid identification of objects. Frequently, our colleagues have commented in a jesting manner, that what the photo interpreter needs is a device whereby he pushes a few buttons and out comes the answer.

We haven't quite reached this phase yet. I doubt whether we ever will. But let us consider for a few moments the benefits which could be gained from a mechanical P.I. Key. In recognizing objects, the interpreter must often deal with a vast amount of detail shown on the aerial photograph, frequently few are really important clues to the identification. The purpose of any key is to focus the interpreter's attention on these significant clues. A mechanical P.I. Key not only isolates these identification features, but guides the interpreter through the identification process. The inexperienced photo interpreter is often in doubt as to what he is really looking for. Even the experienced and specialized photo interpreter, not familiar with his specific subject, sometimes searches frantically for a small clue to help him solve a difficult problem. With a mechanical P.I. Key, consistent and dependable results could be achieved with little chance of errors. Of the various types of mechanical keys developed, the punch card key in my opinion is perhaps the most effective.

My subject is the punch card key developed by the Naval Photographic Interpretation Center and on which a patent application is currently being processed by the Navy. The basic concept of the punch card key is similar to the long established IBM system.

When this key was initially discussed, there were many factors which the inventors had to consider. The following requirements were believed to be basic for a key of this type.

1. Reliability in its final result.
2. Simplicity in its construction.
3. Small in size and compact.
4. Practical, quick, and economical upkeep.
5. The possibility of obtaining a correct answer even when minor errors occurred during the selection of similar characteristics of subjects.

The punch card key has been successfully adapted to a number of different subjects. It has been demonstrated that this key has a practical application in many fields. It has been most applicable to the identification of man-made objects. A contract for the production in quantity of the first key of this type is currently being negotiated by the Navy.

Continuation of the research and the selection of other subjects to be integrated in this new type of key-system, will require the assistance of many highly specialized and experienced photo interpreters.

I believe this punch card key which serves military photo interpreter requirements so well can serve civilian needs just as well. Therefore, I hope that this discussion will stimulate your thoughts and bring forth many new applications employing this device.

The punch card key consists of a binder, several envelopes and numerous cards. The inside front cover of the binder is used as a working board.

Figure 1 shows the general design of the punch card key. The working board consists of two posts, below which numbers from 1 through 40 are arranged. More numbers can be added if needed. To the right of the working board are a series of pocket type subject envelopes. In each envelope there are several cards, each of which deals with a major characteristic pertinent to the identification of the subject. In addition to a brief description of the characteristic, sketches are inserted where it is feasible. If a certain characteristic is not readily discernible in the photography, the photo interpreter is instructed to bypass that particular card and continue working with the remaining cards. At no time should the photo interpreter force the key by guessing. Some latitude was permitted in the selection of descriptive data in cases of uncertainties of images, measurements, or terminology. To avoid possible errors, holes were punched for all of these conditions where an uncertainty exists. For example, length is one of the characteristics frequently employed in the identification of a subject. When so used it is divided into categories such as 21–50, 51–75 feet, etc. For an object 48 feet long, holes have been punched in both 21–50 and 51–75 categories.

Figure 2 shows several superimposed cards placed correctly in line with the descriptive data. By successively imposing the cards more and more numbers are eliminated until only one number remains exposed. This number is keyed to an identification list. This list gives the photo interpreter his answer.

In closing, I would like to state that during the past several months over 300 photo interpretation students at the Naval
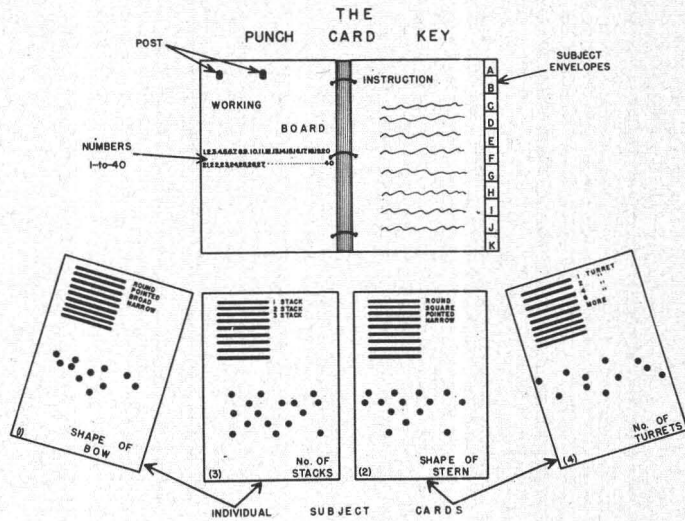
FIG. 1

Photographic Interpretation Center tested this new punch card key device. The results were evaluated and indicated definitely that this system enables them to reach a final identification three times faster and with a 10 per cent increase in accuracy.

DISCUSSION OF MR. WEINER'S PAPER

QUESTION: The device seems very ingenious and certainly a very valuable kind of key. Does your study show what percentage of attempts at interpretation result in incorrect answers?

MR. WEINER: There is rarely any kind of incorrect answer if one does not force the key. I have found that this particular key is especially good for man-made features. Insofar as we have tested them, they have been found to be quite successful.

QUESTION: Have you encountered subjects with characteristics that make them unsuitable for this kind of approach?

MR. WEINER: I have worked only in terms of man-made subjects. For the application of this principle to natural objects—such as landforms—the geologists
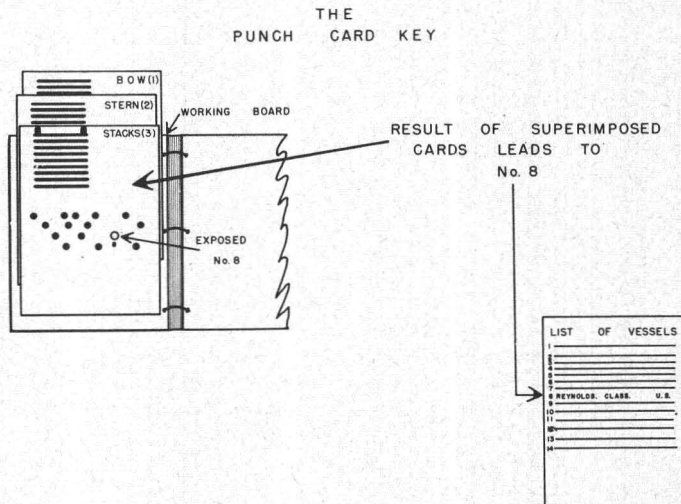

FIG. 2

cannot agree among themselves. Since I am a P.I. specialist without geological training, I could not assemble such a key myself. This type key is really only in its initial stages of development. It has a long way to go. It is the concept of putting things together in such a form that an inexperienced person is told what to look for, how to look for it, and so that he can achieve results rapidly and accurately.

QUESTION: By putting your information in one compartment until use is necessary, is there a possibility that you might limit its scope?

MR. WEINER: Not necessarily. Because the arrangement at the present time is such that you could have many different envelopes and it is not necessary to have them in the binder, itself.

QUESTION: There is an interesting analogy to this punchcard, even in mineralogy. The mineralogists have used a key for many years in the identification of minerals, but they don't use a punchcard key. Instead it is an elimination key based on the physical properties of the minerals. A few years ago Dr. Earl Butt put out a punchcard key. I had one of them and at first, when I handed one to the students, they were very thrilled with the use of the punchcard key because it did the same work, and was very different. But they soon discarded it in favor of the old tabular representation of the same information, because this method was actually quicker than using a sorting needle and working with holes. I wonder if this same kind of information couldn't be put in a properly arranged page instead of using cards?

MR. WEINER: There are integrated selective keys and dichotomous keys, etc. This is just a different method of presenting a key. I have not been aware, until you mentioned it, that another punchcard key is in existence. The Naval Patent Branch has searched the Washington Patent Office, and has not come up with any such information. I certainly would be very interested if you could give me more information.

QUESTION: You mentioned a very great improvement in speed and in accuracy through using this key, but I don't think you gave the basis of comparison. What is that basis?

MR. WEINER: At present we use the regular integrated selective key to identify the given object. Many times the interpreter may have to go through the whole key in order to identify the object concerned and even then he very often is in doubt. This is because he frequently doesn't really know what to look for. The punchcard key, by telling him right off the bat what to look for, can save him one minute on each step. This key has beed tested in classroom exercises.

QUESTION: In examining 300 people, was it always the same people that took the various examinations?

MR. WEINER: No. They were entirely different people. The Naval Photo Interpretation Center has a Training Center where students are being trained continuously. There are always new groups. Under such conditions we were able to estimate how well or how poorly this particular subject was being worked out.

QUESTION: After using such a key about 3 or 4 times, would you not be so familiar with the object that you would be able to identify it without using the key?

MR. WEINER: No, because you will always have different objects in front of you. The more a person uses a key, however, the more familiar he becomes with the different phases and characteristics which have been outlined to him. If he continues to use that key, before long he may remember that certain types of objects have specific characteristics. For instance, most of us can look at a car and tell a Chevvy from a Ford, and a Ford from a Hudson or Studebaker. Why? Because in our daily lives we have become so used to looking at cars, that by just looking at the hood, frame or the hub caps, we immediately recognize a particular make. But this can scarcely be applied to the millions of objects which form images on airphotos.