274 or about 85 per cent which are in full accordance with the gesture theory.

Having come to these results, I went on to examine Hebrew to find out whether these rules prevailing in Ide. were also to be seen in the Semitic group, and I found the rules for Ide. fully confirmed.

Hebrew *gulgoleth* means head or skull. This form is undoubtedly a reduplication of the Hebrew root *gv-l*, which means to move in a circle (cf. Icelandic *kollr* head). Thus we have the same original meaning of the head as in many Ide. words for head, 'round', and we notice that the sound *gv-* has come into existence by a circular or, rather, a half-round movement of the speaking organs.

Hebrew *chek* means palate, belonging to the root *chnk*, which means to anoint the mouth of new-born children with date-juice. In Ide. we can compare *keg-*, *keng-*, *kek-*, *kenk-*, in Ags. *haca* hook, Russian *kógotb* a curved iron-nib, and thus we see an accordance with Ide. both in the form and the meaning. Hebrew *gab* means eyebrow, belonging to the root *gb-b*, which means to vault, be vaulted. In Ide. may be compared *ĝebh-*, *ĝep(h)* jaw, really 'the curved', and *ĝeb* (*h*) branch, really 'the curved'.

Hebrew *qereb-* means intestines, chest, mother's life, formed in a similar way as Ide. *gwer(e)bh*, in Greek βρέφος, which means foster, embryo, and Ide. *gwelbh* mother's life, in Greek δελφύς, the original meaning in both groups being 'the vaulted'.

Hebrew *kaph* means the hollow hand, related to the Hebrew verb *kph-ph*, which means bent, curved, and it is evidently formed like *kap-* in Latin *caput*, which originally meant bowl, cup, in imitation of the curved line from the back of the palate downwards to the *a*-position and upwards to the lips.

Of 78 Hebrew names or parts of the human body, I have been able to explain 61 by means of the gesture theory, or about 80 per cent. This does not mean that the relationship between Ide. and Semitic is a proved fact; but only that the pre-Semitic *Homo sapiens*, like his Ide. counterpart, learned to speak by imitating with his speech organs the gestures of the hands, which was the chief means of communication before the period of the birth of language.

I have come to the conclusion that the third consonant in most Hebrew roots generally is a later addition to a primitive sound—a determinative, corresponding to the Ide. suffixes, because the movement of the speech organs is perfect without this addition, which only gives a fuller definition of what is contained in the first two consonants, or really a consonant+vowel+consonant. This becomes clear when we consider the nature of posture and gesture sounds. Posture sounds are the vowels *a*, *i* and *u* (and *e* and *o*), gesture sounds are all consonants. Two consonants with an interjacent vowel show a movement:

(1) From the palate forwards to the lips or teeth (thus we have guttural+vowel+labial or dental, for example, *qap-*, *k̂ad-*).

(2) From the lips or teeth backwards to the palate (thus we have labial or dental+vowel+guttural, for example, *bheg-*, *dek-*); we could call these movements full movements.

(3) From the palate forwards to the *l*, *r*, *n*-position, as these sounds lie very near to one another (especially *l*, *r*) and are produced by lifting the tip of the tongue to the middle- or fore-palate (thus we have guttural+vowel+*l* or *r* or *n*, for example, *k̂el-*, *ker-*, *ken-*).

(4) From the lips or teeth backwards to the *n*, *r* or *l*- position; thus we have labial or dental+vowel +*n* or *r* or *l* (for example, *bhel-*, *bher-*, *bhen-*, *dhel-*, *dher-*, *dhen-*). We could call these movements half-movements.

(5) From the *l*, *r* or *n*-position forwards to the lips or teeth, producing *l* or *r* or *n*+vowel+labial or dental (for example, *lāb-*, *lat-*, *rab-*, *reth-*, *nebh-*, *ned-*).

(6) From the *n*, *r*, *l*-position backwards to the palate, giving *n* or *r* or *l*+vowel+guttural (for example, *neĝh-*, *req-*, *legh-*), and these movements we could, of course, also call half-movements.

There are still other possibilities as, for example, guttural+vowel+guttural, labial+vowel+labial, dental+vowel+dental, *r*+vowel+*r*, and in the same way *l* and *n*. There is the possibility of double consonants at the beginning or ending of a root, and also the many possibilities with vowel+consonant.

From this point of view, and concluding that the third consonant in Hebrew generally is a later addition, we can compare a vast number of Ide. and Hebrew roots.

All these three special examinations, which I hope to publish fully in English, have confirmed the gesture theory as described in my book mentioned above and by Sir Richard Paget in various publications.

AVIATION AND SCIENTIFIC RESEARCH

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THE Congrès de l'Aviation Française held recently in Paris has given French research workers an opportunity of showing the important role which aviation can take as an instrument in scientific research. A section called "The Application of Aviation to Scientific Research" was formed this year, and a comprehensive survey has been made from numerous reports of new conceptions with regard to various applications.

The fields of research from the point of view of aviation can be placed under three headings: the stratosphere; the atmosphere; and the surface of the earth.

The stratosphere is to the physicists, among others, the region in which cosmic rays are most readily observed. Nowadays it is no longer necessary to confine ourselves to observatories on mountains or small 'laboratories' in the form of sounding balloons. It is only the aeroplane that can remain at high altitudes with observers and a useful amount of apparatus for an appreciable time. French scientific workers consider that in the next few months it will be possible to study the nuclear phenomena of cosmic radiation at 14,000 m. (46,000 ft.) with a useful load exceeding two tons.

The atmosphere abounds with 'aerial plankton' and so is of great interest to naturalists. So long ago as 1920, scientific workers in the United States began to investigate this subject. In Europe, Lucian Berland devised a method of trawling which enables small organisms (insects, spiders) and vegetable matter and inorganic particles to be collected at 5,000 m. (16,500 ft.). The former are present because, being only moderately strong flyers, they are thus unable to resist the up-currents in the air. Studying these organisms will give insight into the distribution of various living organisms and the stocking of certain remote lands, especially oceanic islands.

The currents and composition of the atmosphere, particularly above water, are equally interesting to the hydrobiologist, because water is the medium of transport of great quantities of nutrients.

However, it is the surface of the earth which still attracts the greatest attention, and it is here that the aeroplane is unsurpassed for photographic work. It is unnecessary to state the advantages in speed and accuracy of this method for preparing maps. The French Geographical Institute has been allotted a squadron of special aircraft to prepare within a reasonable period maps of territories overseas.

The immediate rewards of air survey are of a morphological character and are related to physical geography: tectonic phenomenon, erosion, and hydrological events are clearly visible. Aerial photography is used in regular hydrographic surveys to plot the topography of the coast and of the bottom of the sea. It is also considered possible to study sea surges by aerial photography and photogrammetric methods. The evolution of the coast-line by sea erosion can, of course, be readily followed by this means.

In France, aerial photography is being used for the preparation of maps of vegetation (1 : 200,000) for both the pure or applied botanist. This work is undertaken by the National Centre of Scientific Research, and is being used to plot classified forest and other reserves. Overseas, photography will allow the survey of remote and secluded areas of vegetation (different types of forest, savannas, etc.).

Again, photography from the air gives more complete information about the distribution of man on the earth, and is thus of interest to the archæologist, the prehistorian and ethnographer. Aerial photography has proved a trustworthy method of studying the past. By making use of oblique background lighting, it makes clear organisations and communities of thousands of years ago. Father Poidebard, so early as 1925, discovered in Syria the details of the line of contact between the Romans and the desert tribes of the Euphrates region. In his last expedition, finishing in 1939, he constructed a plan of the economic organisation of Upper Roman Syria. The novelty of the method employed consisted in combining epigraphic research with the reconnaissance aeroplane. In the buried ruins found in the desert, the first details that appear when seen from a high altitude are the entrances to the buildings and towns; it is there that important inscriptions are found which fix the date of origin. Aerial photography also allows us to locate ancient remains even when the ground is level; for vegetation generally flourishes more vigorously on the foundations of ancient buildings, mounds and ditches; and it turns yellow more quickly on the sites of paths and walls.

But the earth is above all the setting for human phenomena; migrations, pilgrimages, battles, engagements and deployments of troops may be assessed by studying the photographs.

By means of aerial photographs it is possible to fix the transformations of natural boundaries during annual and seasonal variations due to the rotation of crops. Again, slower variations, digressions, alterations or extensions of certain operations of Nature or man have an insensible effect otherwise difficult to assess: such as the regression of grazing land on the high Algerian plateau, the instability of river banks in the north Cameroons and the shrinking of vegetation in certain tropical countries. It reveals the movements of the subsoil, upon the fertility of which mankind depends.

Aerial photography contributes more than psychological aid to the ethnographist carrying out researches on the ground. It constitutes an incomparable method for investigating the human race, presenting a true picture of its disposition. Aerial photographs are also intelligible to primitive peoples, after a certain amount of instruction, as opposed to maps, which remain a closed book to them. It also penetrates real secrets in revealing hidden villages and clearings in forestry reserves; and more particularly in disclosing the details of walled courts, terraces and enclosures which are hidden from terrestrial exploration. It equally allows the establishment of an exact and detailed topography which may make apparent otherwise inexplicable phenomena on maps (sacred ruins, mythical voyages, etc.).

The aeroplane is one of the most precise tools for scientific research on the progress of human evolution and for examining the natural boundaries of the earth. This task is still only in its early stages. With the aeroplane used on the grand scale, the problem will be completed in decades instead of the centuries which would be required by the classical methods of investigation.

PHYSICAL PROPERTIES OF MICA

MICA is so critical a material for the manufacture of electrical equipment that, during the War, it was often referred to as "*the* most important single war material". Without it there would probably not have been any radio or radar, gun control or detector devices. In peace-time, mica is equally important for it is an indispensable component of many domestic and industrial electrical appliances. It is used in condensers, radio valves, heating elements, X-ray apparatus, electrical machinery, temperature control apparatus, etc., and is preferred to other good electrical insulators because it can also be split easily to any desired thickness. As a component of such appliances it is naturally subjected to all kinds of varying physical conditions and it is therefore essential to have an accurate knowledge of the physical properties of mica.

As an outgrowth of certain tests made in connexion with a military problem, P. Hidnert and G. Dickson have obtained data on the linear thermal expansion, changes in structure, power factors, and effects of heat treatment on thickness, opacity, and colour of micas (*Bur. Stand. J. Res.*, 35, 309; 1945). Fifty samples in all, consisting of five types of micas (muscovite, phlogopite, biotite, ripidolite and zinnwaldite), from different sources and of different qualities, were examined. No chemical analyses were made of the samples.

For the thermal expansion measurements, the fused-quartz tube apparatus of Hidnert and Sweeney (*Bur. Stand. J. Res.*, 1, 771; 1928) was modified, so that short cylindrical specimens of mica could be used. All the thirty samples investigated were under load (about 2 kgm./cm.^{2}) when the measurements were made. Results are given for the linear thermal expansion in the direction perpendicular to the cleavage plane over the range 20° C. to 600° C. (in some cases 700° C.). A few of the phlogopite and biotite samples have extremely high coefficients of expansion, many times that of any other known solid material. These micas, in combination with a metal, alloy or non-metallic material, would, when heated or cooled, produce a large differential expansion or contraction. They are, therefore, most useful as high-