is slightly convex and not depressed, as in recent man. The upper jaw therefore must have projected considerably. The palate is broad and high.

Earlier (1935) I was able to demonstrate that a close connection between *Sinanthropus* and certain groups of the present Mongol race could be assumed. The occurrence of the so-called "torus mandibularis" on the inner side of the mandible of some of the *Sinanthropus* jaws as well as on those of recent Mongols, especially Eskimos and Lapps, and furthermore the occurrence of shovel-shaped medial and lateral upper incisors in *Sinanthropus,* as also in modern Mongols, indicate some direct relationship between Peking Man and the Mongol group of recent mankind. Whether or not the broad and flat nose of *Sinanthropus* points to the same direction I do as yet not venture to state. However, in addition there is another conspicuous feature which, I believe, serves as further evidence for the assumption of such a special relationship. All three adult skulls show a large "inca-bone" (*os epactale*) which, it is true, is not confined to the ancient Peruvian natives, as the name suggests, but also occurs in other races of to-day. However, it is much more frequent in the American Indian and Mongol group (up to 7.8 per cent.) than in the latter (up to 2 per cent.).

As to the relation to *Pithecanthropus, Sinanthropus* Skull II of Locus L, together with the fragmentary *Sinanthropus* of Locus I mentioned above, prove incontestably that there is no appreciable difference between *Pithecanthropus* and *Sinanthropus* as far as the general shape and the lowness of the skull caps are concerned. Since it has been assumed that these two *Sinanthropus* skulls belong to female individuals, it is very probable that *Pithecanthropus* also belongs to the same sex, a probability which had already been pointed out by E. Dubois and Hrdlička. The *Sinanthropus* skulls differ from *Pithecanthropus* by only two characters, namely, in that the frontal bone proper is more vaulted in *Sinanthropus,* although its inclination to the glabella-inion line is distinctly more pronounced than in *Pithecanthropus.* Furthermore, the supraorbital ridges of *Sinanthropus* are separated from the forehead by a really broad furrow, while in *Pithecanthropus* they continue gradually to the brow. The latter phenomenon, however, seems to have some connection with the formation of the frontal air-sinuses. In *Pithecanthropus* these sinuses are conspicuously large and extend far lateralward over the roof of the orbit, whereas in all cases of *Sinanthropus* they are very small and closely confined to the interorbital region. I consider this appearance in the case of *Sinanthropus* as an indication of its being more primitive than *Pithecanthropus* and the latter, in spite of the absence of prominent frontal tubera, as a more advanced type of hominid.

Another important fact is disclosed by *Sinanthropus* Skull I of Locus L. This skull is not only the largest of all *Sinanthropus* skulls recovered hitherto (*ca.* 1,200 cc) but at the same time also the highest. Although its general structure and essential details show the same characters as the lowest Skull II of Locus L, yet its greater cranial capacity approaches closely the more primitive representatives of the Neanderthal group. I had earlier (1936)[4] assumed that there must be some relation between *Pithecanthropus* and *Javanthropus soloensis,* the latter resembling the former in several primitive characters. On the other hand, there is no doubt that *Javanthropus* has many peculiarities in common with *Sinanthropus,* as recently demonstrated by C. U. Ariens Kappers (1936)[5] in regard to the endocasts. I should not be surprised if *Pithecanthropus* at some future date should be found to represent nothing else but a special female type of *Javanthropus.* Since *Javanthropus* as a whole represents a very primitive form of Neanderthal Man, the line linking *Pithecanthropus* and *Sinanthropus,* respectively through *Javanthropus* or Neanderthal Man to recent man is continuous. The fact that there may be certain racial deviations does not matter greatly, since the determining factor does not depend on relatively minute differences but on the main course of human development itself.

FRANZ WEIDENREICH
PEIPING UNION MEDICAL COLLEGE
AND CENOZOIC RESEARCH LABORATORY,
GEOLOGICAL SURVEY OF CHINA

EXCHANGES BETWEEN BLOOD PLASMA AND TISSUE FLUID IN MAN

IN previous publications[1] we have shown, with normal men, that brief violent exercise produces a sudden transudation of up to 20 per cent. of the plasma water from the blood to the tissues. The return of the volume and the general concentration of the blood to the resting level follows, approximately, a logarithmic deceleration curve and requires about an hour. In these exchanges the water is accompanied by a small amount of proteins which are highly active osmotically (*i.e.,* their molecular size is small). This does not mean that the capillaries are extraordinarily permeable. The plasma calcium, including the so-called "diffusible" fraction, does not escape across the capillary wall more readily than does protein under these conditions.

The behavior of the sodium concentration in experiments of this type (exhaustion produced in 1 minute) throws further light on the permeability of the capil-

[4] *Idem, Peking Nat. Hist. Bull.,* 10: 4, 281–290, 1936.
[5] C. U. Ariens Kappers, *Jour. Anat.,* 71: 61–76, 1936.
[1] Keys, *Jour. Biol. Chem.,* 105, xlvi, 1934; Keys and Taylor, 1935, *ibid.,* 109, 55; Keys and Adelson, *Amer. Jour. Physiol.,* 115: 539, 1936.

lary wall. In all cases (15 subjects) the sodium concentration in the plasma immediately after work is from 2 to 10 per cent. above the resting level, but the recovery is rapid. In 15 minutes $[Na]_S$ is very nearly at the resting level; at this time the return of water to the blood stream is only 60 to 75 per cent. complete. Apparently, the rate of exchange of sodium across the capillary wall is markedly less than that of water but is still very rapid in comparison with the readjustment of the blood volume.

The behavior of the plasma potassium is very different. Immediately at the end of work $[K]_S$ may be as much as 25 per cent. above the resting level, but it drops precipitously. After 10 or 15 minutes the level is from 5 to 15 per cent. *below* the resting level. $[K]_S$ then begins to rise and exceeds the resting level as much as 20 per cent. at 40 minutes; the resting level is regained in from 1 to 1½ hours. This remarkable cycle is consistently found (6 subjects); it is not due to hemolysis or exchanges with the red cells.

Intravenous injections of adrenalin (0.05 to 0.2 cc of 1 to 1,000 solution) produce a rise in blood pressure and a general hemoconcentration similar to the effect of brief exercise, but the response of $[K]_S$ is different. We have found no initial rise of $[K]_S$ resulting from adrenalin. $[K]_S$ decreases from 4 to 15 per cent. below the resting level within the first few minutes; thereafter $[K]_S$ rises, reaching from 5 to 15 per cent. above the resting level after about an hour.

The exchanges of Na, Ca, H_2O and protein are readily interpreted in terms of osmosis and different rates of diffusion through the capillary walls. From preliminary results this seems also to be true of sulfate and Cl. Such explanations are totally inadequate to account for the potassium exchanges. It may be noted that it is possible the secondary fall and subsequent rise of $[K]_S$ beginning about 8 minutes after exercise may be entirely analogous to the changes in $[K]_S$ following adrenalin; in fact, these delayed effects may be due to a delayed production of adrenalin. However, such a theory would not account for the adrenalin effect itself nor would it throw any light on the immediate effect of exercise on the $[K]_S$.

These results were obtained from duplicate, triplicate and quadruplicate analyses, which agreed within about ± 1 per cent. These experiments will be published *in extenso* in the near future. The potassium method will be published separately.

ANCEL KEYS

THE MAYO FOUNDATION
ROCHESTER, MINN.

THE PLANT ORIGIN OF A VITAMIN D

IN the animal kingdom the vitamin D group is widely distributed, but only in the fishes has it so far been found in great concentration. To account for this, Steenbock and Black[1] suggested that the vitamin might originate from the solar irradiation of plankton. Attempts to support this hypothesis have so far been consistently negative in phytoplankton,[2,3] although results of doubtful significance have been reported with zooplankton.[4,5]

Spectrographic studies[6] on the presence of ultraviolet light below the surface of the sea, made at the Tortugas Islands where the water is very clear, have shown a high intensity of relatively short wave-lengths in the first three feet. In the light of these findings, the Sargassum weed seemed a logical form to investigate for the presence of vitamin D. This alga grows at shallow depths in the clear waters of the Caribbean. Although there is doubt as to whether some forms originate at the bottom and later lose their attachments, all species float and grow on the surface for some months, small sprigs at times protruding as much as 10 cm above the water.

We therefore tested the lipin fractions of *Sargassum* for antirachitic properties. Samples collected in the Gulf Stream off Cape Hatteras during May and off the Tortugas during July have yielded oils (in amounts corresponding to 2.5 and 3.0 per cent., respectively, of the dry material) which are definitely curative for rickets. The Sargassum from the Tortugas, after several washings in fresh water to remove accompanying animal forms, furnished a lipoidal mixture which was active in rat-doses of less than 3 mg divided over 8 days. Oils from *Ulva* and *Laminaria* collected off Cape Cod during August were inactive at much higher dosage levels. More exhaustive assays are in progress, and the determination of the rat-chicken activity ratio is planned.

The product from the Hatteras collection of *Sargassum* has been subjected to chemical examination. The unsaponifiable fraction, amounting to 28 per cent. of the oil, yielded about 20 per cent. of a colorless crystalline sterol apparently identical with the fucosterol isolated by Heilbron *et al.*[7] from *Fucus vesiculosus*. This sterol, which was purified by crystallization only, without the use of charcoal, exhibits no selective absorption in the ultra-violet region, and therefore[8] contains neither a vitamin nor a provitamin of the D

1 Steenbock and Black, *Jour. Biol. Chem.*, 64: 263, 1925.
2 Leigh-Clare, *Biochem. Jour.*, 21: 368, 1927.
3 Drummond and Gunther, *Nature*, 126: 398, 1930; *Jour. Exp. Biol.*, 11: 203, 1934.
4 Belloc, Fabre and Simonnet, *Compt. Rend.*, 191: 160, 1930.
5 Copping, *Biochem. Jour.*, 28: 1516, 1934.
6 Darby, Johnson and Barnes, Papers from the Tortugas Laboratory, in press.
7 Heilbron, Phipers and Wright, *Jour. Chem. Soc.*, 1934: 1572.
8 Gillam and Heilbron, *Biochem. Jour.*, 30: 1253, 1936.