Kwakiutl North American Indian mask of "born-to-be-head-of-the-world" collected by George Hunt, Franz Boas's field assistant, in 1901. From *American Museum of Natural History* (see p.589).

as satisfactory by the 'minimum string' concept, may look quite different. I agree wholeheartedly though with the author's statement that:

> The a priori knowledge that most human genetic variation is polymorphic, rather than polytypic, should make it more important to preserve many samples from relatively fewer groups, than to preserve few samples from many groups, if one wishes to study the general extent and nature of human genetic diversity.

In dealing with the adaptive nature of human variation and the 'health' differences between populations, Marks unsurprisingly concludes that although such human traits as bipedal locomotion, large cranial capacity and pelvic structure are adaptive, the adaptive significance of most within-human variation is obscure, apart from such examples as skin pigmentation and the sickle-cell trait. Furthermore, ethnic differences in disease patterns are not related to genetic variation, again with a few exceptions such as malaria resistance due to the possession of the sickle-cell trait.

Marks also returns to the hoary question of "Human Traits: Heritage or Habitus?", where heritage is defined as inborn (that is, genetic) and habitus as acquired (that is, culturally imposed). Dismissing all comparisons of the behaviour of humans with that of non-primates, he writes:

> When we confine ourselves to our close relatives, however, we find (1) such a difference between human behavior and that of the apes, and (2) such a diversity of behaviors among the apes that it becomes difficult to argue for much of any human behavior being the result of heritage rather than of habitus.

Although granting that "human behavior, like all phenotypes, has a genetic component", Marks then develops the case that "it is difficult, if not impossible, to match genes to behaviors". Geneticists interested in the genetic basis of deviant behaviour will find his discussion stimulating.

Marks ends by reiterating a dominant theme of the book, that scientists dealing with human differences have social responsibilities not shared by those dealing with differences between clams or fruitflies, responsibilities too often abused in the past. Nor is he too happy with the present: "We seek a path of self-awareness through genetics, yet we are constantly led into intellectual cul-de-sacs". The overarching theme of this book is that despite the obvious differences between individuals and groups of individuals, the similarities are now seen as so great, and the gradations between groups so subtle, that attempts at ethnic classification are almost reduced to a trivial pursuit. But as he says in his concluding sentence, "it is tempting to commit those mistakes again and again". This book will be much discussed. Read it. □

James V. Neel is in the Department of Genetics, University of Michigan Medical School, Ann Arbor, Michigan 48109-0618, USA.

Current revolutions

Andrew Holmes-Siedle

The Quantum Dot: A Journey into the Future of Microelectronics. By Richard Turton. *W. H. Freeman/Oxford University Press: 1995. Pp. 211. £11.99 (pbk), $25 (hbk).*

GIVEN the need for information technology to progress continually, what is the next step when we have exhausted the possibilities of microelectronic devices on silicon? One answer is quantum dots, wells and wires. Although the author has chosen a catchy, futuristic title alluding to these possibilities, he deals with them only in the second half of the book.

Quantum dots are minute microelectronic structures usually made of III–V compounds such as gallium arsenide. The scale of the structure, about 10 nm, is small enough to allow the wave properties of the electron to come into play. Using the growth of films of III–V compounds by molecular-beam epitaxy, linked with submicrometre lithography, such 'droplets' can be produced in tightly packed arrays, and 'quantum wells' can be made inside. The well is like a little box (or conduit), suitable for handling a single electron. These III–V compounds also convert current to light, so optoelectronic methods can be explored. Very small packets of charge can be piped around these structures — smaller packets than are possible for silicon. Here lies one of the possible waves of the future. AT&T is exploring it, so there must be something in it.

This is primarily a book on integrated circuits, however, firmly footed in the silicon age. Intended for the uninitiated reader, it outlines the basic principles of how countless functions are packed into a small 'chip' — mostly using device physics from before the age of quantum wells — and ends with a useful explanatory description of the possible next steps after silicon.

Whenever I explained to my late mother-in-law the design of a silicon chip, she usually responded by asking: "How ever do you think of these things?" Modestly, I would reply by saying that it was not me alone who did the thinking, that I had been trained to and so on. But the question has resonance. Although not the main purpose of the book, one of its merits is that it gives a hint of just how we do think of these things. With unusual thoroughness — one might say patience — the author explains the physical effects used in the design of semiconductor devices in terms of simple concepts, drawing analogies to tennis balls and pieces of string. One could say that he has reduced semiconductor physics to childish concepts. This is not intended as a sneer; while looking at the pictures, it occurred to me that, for some of the best scientists I know, the process of clarifying physical observations consists of reduction to very childish concepts. It is the drive to their thinking; only later comes complexity, when the concepts are subjected to the trappings of conventional disciplines such as those of mathematics or computer software.

At least the author avoids talking about 'silicon chips'. Long gone are the days when device designers, like woodsmen, hacked a piece of semiconductor off a crumbly ingot. Chips are crafted by large expensive machines, and ingots are six feet long. But the mechanics of production is only lightly touched on here. The author concentrates on the physics of the products.

It is a pity that he did not run the manuscript past an electronic engineer: the description of the basic MOS gate logic circuit is completely wrong. But the physics is sound, and, more to the point, can be understood by the lay reader. The book's occasional factual defects should not prevent it from encouraging readers to explore further how we may control and channel electrons and holes in electronic gadgets. Its usefulness need not stop at the lay person; an intuitive scientist will also get a charge out of it. □

Andrew Holmes-Siedle is in the Department of Physics, Brunel University, Uxbridge UB8 3PH, UK.