

were of the Caucasian race and came by way of Micronesia from Indonesia to Samoa. They produced a hybrid race and the south-east Polynesian type of culture. A fairly pure group of this Caucasian race reached the Marquesas and, mixed with the Negroids, arrived in Easter Island. Another group passed through Melanesia and modified the culture of the Eastern Melanesian Islands. The last comers were the Indonesians, who entered by way of Micronesia and thence passed to Tonga and, mixed with earlier people, to Hawaii. In Samoa they were resisted for a time by the earlier population, which in Niue survived into historic times. From Western Polynesia the Indonesians colonised New Zealand, spread over South-east Polynesia and reached the Marquesas. Later movements from the west have modified the culture and rendered it extremely complex.

In Mr. Sullivan's study of Marquesan, Samoan, and Tongan somatology, the distinctions of race are elaborated in a series of anthropometric tables based upon the examination of 84 adult men and 74 adult women of the Marquesan islands. These were compared with his similar studies of Samoans and Tongans in other papers. His estimate of the physical condition of the people has been already quoted. The measurements show the Marquesans to be "tall, with long, wide head, a high, wide face, and a high, wide nose. All of the dimensions of the head and body are large, indicating their massive size. They are on the verge of brachycephaly. But one cannot be sure that the heads are wholly undeformed."

According to Mr. Sullivan the "Polynesians" of the Marquesas, Samoa, and Tonga are a mixed people. He finds in them three racial types. In addition to the Polynesian population there is a second type resembling the Indonesian peoples of Malaysia, and a third extremely short-headed element. He has dealt mainly with the Polynesian and Indonesian types. The former are taller, with longer heads, higher faces, narrower noses, perhaps straighter hair, more beard and body hair, and lighter skin than the Indonesians. They appear thus to be the Caucasian people of Mr. Linton's hypothesis.

Mr. H. D. Skinner's monograph on the Morioris is exhaustive as regards the material culture of the people and their relation to the Maoris and other Pacific islanders. It is prefaced by an admirable summary account of the bodily and mental characteristics of the Morioris, their language, social organisation, and religion. This is derived partly

from the very scattered accounts of earlier writers, but has been considerably extended by Mr. Skinner's own investigations in the Chatham Islands. As in the Marquesan papers, the illustrations are an important feature. The paper before us contains thirty-six figures in the text, and thirty-five full-page plates.

With regard to the origin of the Moriori, Mr. Skinner gives a summary of their own traditions as recorded by Shand and the Maori version of Whatatoro, which was accepted as accurate by Mr. Percy Smith and Mr. Elsdon Best. The Moriori account seems to show at least two principal immigrations from unknown lands, the last of which took place, if the genealogies may be relied upon, about thirty generations ago, or about A.D. 1175. According to the Maori account they were a portion of the original inhabitants of New Zealand, called Maruiwi, who had been driven by a storm while fishing from a great land south-west of New Zealand. Mr. Skinner points out the inherent improbabilities of this story: the presence of women in a fishing party, the food required for a thousand-mile journey, and the impossibility of people in the cultural stage attributed to the Maruiwi possessing ocean-going canoes. The Maruiwi, moreover, were the physical antitheses of the Moriori. They were tall, thin, dark-skinned, with flat noses and straight hair, whilst the Moriori are short and bulky, brown-skinned, with prominent noses, and hair often waved and sometimes frizzy. The Maruiwi lived wholly on forest produce, and knew nothing of fine weaving, but the Morioris had a traditional knowledge of cultivated plants, and made fine matting. Not one of the Moriori weapons described by Mr. Skinner is mentioned in the account of the Maruiwi.

Mr. Skinner's final remarks are important. The craniology of the Moriori shows close relationship with the Maori, and some social features are identical. The language is divergent, but Mr. Skinner suggests a likeness to the Kaitahu of South New Zealand. The evidence of material culture is decisively in favour of a Maori origin, though some evidence appears of a likeness with Easter Island and Melanesia in the conception of human and animal forms in art, and in some hooks and adzes.

Taken as a whole these three studies considerably increase our knowledge of the Polynesians. But their conclusions have yet to be compared with the evidence of language, sociology, and religion.

SIDNEY H. RAY.

Ancient and Modern Arithmetic.

THE special object of the papers referred to below¹ appears to be to establish one main thesis, namely, that there was no such thing as arithmetic in our modern sense before the sixteenth century. To quote the author's words: "Modern arithmetic, which is a peculiarly Western invention, is yet barely 400 years old. Prior to 1500, and during some 3500 years of unbroken mathematical continuity and evolution, the science and art of calculation differed absolutely from anything in vogue with us."

The sole direct argument by which the author supports this thesis is the occurrence, in two particular treatises on arithmetic which he quotes, of a method of multiplying two digits to which he applies the general term "calculation by deficiencies." The anonymous English author of "An introduction for to lerne to reckon with the pen, or with the counter,

according to the trewe cast of algorism, in hole numbers or in broken, etc.," written in 1546, multiplies 7 by 5, and for this purpose substitutes (10-3) for 7, arriving at the result by a process which is equivalent to $7 \times 5 = (10-3) 5 = 50 - 15 = 35$. The Frenchman Oronce Fine (not "Finé"), whose work was first published during the years 1530-32 (not 1525), uses an even more roundabout process equivalent to $7 \times 5 = (10-3) (10-5) = 15 + (7-5) 10$ [or $(5-3) 10 = 15 + 20 = 35$].

Now this "complementary" method of multiplication (as it has been called) is a familiar item in most histories of mathematics: there is nothing new in Prof. Brockwell's discovery. He says, indeed, that the anonymous English treatise "appears to have been entirely overlooked by all the more recent writers on the history of mathematics both in Europe and America"; but, if he had referred to David Eugene Smith's "Rara Arithmetica" (1908), he would have found (p. 244) a notice of this anonymous work and of the later edition of it published in

¹ "The Transition from Ancient to Modern Arithmetic, I. II." (reprinted from *The Teachers' Magazine*, Montreal, Dec. 1923 and April 1924); "Calculation by Deficients (a remarkable aspect of the Evolution of Arithmetic)," a paper read before the American Oriental Society, April 23, 1924; by the Rev. C. A. Brodie Brockwell.

1574. He would also have found in the same "Rara Arithmetica" (p. 76) a case of "complementary" multiplication from an earlier treatise (Huswirth, 1501). But the strange thing is that our author seems to infer from these cases that before 1546 such multiplications were never done in any other way, that "none of our tables of arithmetic had been invented as recently as 1500 A.D.," that "our multiplication-table had not been invented," and that, "while men could multiply, as we do, up to five times five by the fifteenth century, they could not go beyond this." There is, indeed, no trace of multiplication-tables in Egyptian records, but the Babylonians had not only multiplication-tables but also tables of divisions, of squares, of square roots and cube roots. The Greeks and Romans certainly had multiplication-tables: there is one in Nicomachus (about A.D. 100) and in Boëtius (about A.D. 500), and they must have been used much earlier. There are also multiplication-tables in a treatise on abacus-reckoning by Bernelinus (about A.D. 1020), in the "Liber abaci" (1202) of Leonardo of Pisa, and in Widman's Arithmetic (1489). So much for the multiplication-table. (The fact that Pepys had such trouble in learning the multiplication-table is of course no proof that schoolboys and others had then (1662) only just begun to use it, and that it was then little more than 100 years old; other great men have been without a gift for arithmetic.)

The story of the arithmetical operations is similar. Eutocius (5th century A.D.), in his commentary on Archimedes, gives various long multiplications differing from ours only in the arithmetical notation used. Theon of Alexandria (4th century A.D.) divides $1515^{\circ} 20' 15''$ by $25^{\circ} 12' 10''$ and extracts the square root of 4500 in degrees and sexagesimal fractions by a procedure which, allowing for the difference of notation, is the same as ours. Long multiplications in the Treviso Arithmetic (1478) are done in a way exactly equivalent to our method, and in some cases they are written out in exactly the same form. So with long divisions, which appear, in the same form as with us, in an Italian MS. of about 1460 (see D. E. Smith, *op. cit.* p. 462), and in printed works by Calandri (1491) and Luca Paciolo (1494). It is true that some ancient systems of numerical nomenclature expressed certain numbers on a subtractive principle: cf. the Roman *undeviginti* and *duodeviginti* for 19, 18, etc., and the numeral signs *iv.*, *cxc.*, etc. The Babylonians, too, used the same principle commonly, if not so systematically: e.g. we find 118 written as 120 *minus* 2, and 27 as 30 *minus* 3. Possibly the "complementary" multiplication owes its origin to this feature of the Roman numeral system. But there seems to be no trace in India, Arabia, Egypt or Greece of the "complementary" method of multiplication.

Such being the facts, few, we imagine, will agree that arithmetic was dominated continuously from the earliest times to the sixteenth century by "calculation by deficiencies," and that our modern arithmetic was a Minerva-like offspring of that century.

Prof. Brockwell finds indirect evidence for his theory in a multitude of allusions in literature which hint at odd systems of numeration and curious processes of calculation. He draws mostly from Hebrew and Biblical sources and states a number of interesting puzzles, e.g. "Why from time immemorial had *aleph*, the first letter of the Hebrew and Phœnician alphabet, the index both of 1000 and of 1?" "Why, when speaking of the seven days of the first creation story, did the mediæval Hebrew exegetes describe them as seven thousand days?" and so on. These puzzles may no doubt offer a considerable field for further research into primitive arithmetic.

We may observe incidentally that our author assigns Philolaus to the 5th century A.D. (instead of B.C.), making Isidorus, Bishop of Seville (A.D. 560-636), "a little over a century later." He also speaks of Proclus, the Neo-Platonist, as "the Egyptian mathematician"!

University and Educational Intelligence.

LIVERPOOL.—Applications are invited for the Derby chair of anatomy, the duties of which post will begin on January 1 next. The latest date for the receipt of applications by the registrar is October 1.

A DEMONSTRATOR is required in the department of mathematics of the City and Guilds (Engineering) College, South Kensington. The latest date for the receipt of applications and statement of qualifications, by Assist. Prof. Klugh, at the College, is August 30.

APPLICATIONS are invited for two research assistantships in the Physical Laboratory of the University of Toronto. Candidates must be university graduates with special training in physics. Applications should be sent to Prof. J. C. McLennan at the University.

APPLICATIONS are invited for the professorship of surgery in the University of Otago, New Zealand. Particulars of the appointment and a form of application may be obtained upon written request to the High Commissioner for New Zealand, 415 Strand, W.C.2. The completed form must be returned by August 31.

As part of the Vacation Course for Teachers arranged by the West Riding Education Committee at Bingley, Mr. Wilfred Mark Webb, general secretary of the Selborne Society, gave a lecture and demonstration on August 12 dealing with "The Cinematograph in Education." He considered two aspects of the subject, namely, the use of moving pictures in the ordinary curriculum in connexion with the definite teaching of various subjects in which it is recognised that they may be helpful, and during out-of-school hours for broadening the pupils' outlook. He strongly emphasised the need at present of superseding the lantern slide only when it is advisable to represent movements which are going on, or can be introduced as an improvement upon the still picture, and even upon the blackboard, in the building up of drawings, diagrams, or maps, or by making models work upon the screen.

In continuation of the policy of training aircraft apprentices in the skilled trades of the Royal Air Force, two examinations for the entry in January next of more than 500 boys, between the ages of 15 and 16½ at the time of entry, will be held on October 17 and November 4 respectively. The closing date for the receipt of completed forms of application for the first examination, which is an "open" competition conducted by the Civil Service Commissioners, is August 28, and for the second "limited" competition, which is carried out by the Air Ministry in conjunction with the local education authorities, the forms of nomination must be received in the Air Ministry by October 7. For the former, forms of application can be obtained from the Secretary, Civil Service Commission, Burlington Gardens, London, W.1. For the latter, nominations can be obtained through headmasters of schools, Advisory Committees for Juvenile Employment, the Boy Scout Association, and officers commanding Territorial Cadets.