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Letter to NJAS

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Robert G. Wilson

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6 January 1992

Neil James Alexander Sloane
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Subject: A Hdbk of Integer Sequences

Dear Dr. Sloane,

Please find enclosed a table of the first 200 "Fortunate" numbers. "Fortunate" numbers are produced as follows: Multiply the first "n" prime numbers (Seq. Nbr. 688) and add one to obtain the "Euclidean" numbers (these are not listed but their prime factors are in Seq. Nbr. 1081.), $1 + \prod P_k$, P_k is the k^{th} prime number. Keeping in mind this number, find the next prime number ~~and~~ subtract the former and then add one. This is the sequence of the "Fortunate" numbers. References: Am. Math. Mo. v95 n8 p 699-700 & 708, Oct 88 by Richard K. Guy; "A Number For Your Thoughts" p 200 1982 by Stephen P. Richards; and "Solving Math Problems in BASIC" p 71-72 1983 by Thomas P. Dence.

Sequentially yours,

Robert G. Wilson

Ph.D. ATP/CF&GI

A5235

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"Fortunate" nbrs. P is the k th prime.

k	P	F										
0	0	2	50	229	293	100	541	641	150	863	1153	
1	2	3	51	233	443	101	547	877	151	877	1069	
2	3	5	52	239	331	102	557	1423	152	881	947	
3	5	7	53	241	283	103	563	929	153	883	1439	
4	7	13	54	251	277	104	569	839	154	887	1753	
5	11	23	55	257	271	105	571	641	155	907	1231	
6	13	17	56	263	401	106	577	839	156	911	1223	
7	17	19	57	269	307	107	587	971	157	919	1013	
8	19	23	58	271	331	108	593	859	158	929	1237	
9	23	37	59	277	379	109	599	1019	159	937	1153	
10	29	61	60	281	491	110	601	643	160	941	1489	
11	31	67	61	283	331	111	607	733	161	947	1321	
12	37	61	62	293	311	112	613	743	162	953	1181	
13	41	71	63	307	397	113	617	653	163	967	1987	
14	43	47	64	311	331	114	619	1031	164	971	1697	
15	47	107	65	313	353	115	631	1069	165	977	2243	
16	53	59	66	317	419	116	641	983	166	983	1867	
17	59	61	67	331	421	117	643	653	167	991	1193	
18	61	109	68	337	883	118	647	769	168	997	1097	
19	67	89	69	347	547	119	653	691	169	1009	1289	
20	71	103	70	349	1381	120	659	1213	170	1013	1999	
21	73	79	71	353	457	121	661	991	171	1019	1103	
22	79	151	72	359	457	122	673	1091	172	1021	1601	
23	83	197	73	367	373	123	677	2087	173	1031	1453	
24	89	101	74	373	421	124	683	733	174	1033	2131	
25	97	103	75	379	409	125	691	1307	175	1039	1231	
26	101	233	76	383	1061	126	701	1481	176	1049	1163	
27	103	223	77	389	523	127	709	883	177	1051	1063	
28	107	127	78	397	499	128	719	1123	178	1061	1163	
29	109	223	79	401	619	129	727	1523	179	1063	1453	
30	113	191	80	409	727	130	733	1109	180	1069	2357	
31	127	163	81	419	457	131	739	1171	181	1087	3559	29, 281.8
32	131	229	82	421	509	132	743	769	182	1091	1429	
33	137	643	83	431	439	133	751	1801	183	1093	2689	
34	139	239	84	433	911	134	757	1031	184	1097	1597	
35	149	157	85	439	461	135	761	1597	185	1103	1381	
36	151	167	86	443	823	136	769	829	186	1109	3089	
37	157	439	87	449	613	137	773	1201	187	1117	1669	
38	163	239	88	457	617	138	787	1453	188	1123	2099	
39	167	199	89	461	1021	139	797	937	189	1129	1831	
40	173	191	90	463	523	140	809	1091	190	1151	1327	
41	179	199	91	467	941	141	811	1031	191	1153	1867	
42	181	383	92	479	653	142	821	857	192	1163	1759	
43	191	233	93	487	601	143	823	1187	193	1171	2351	
44	193	751	94	491	877	144	827	863	194	1181	2287	
45	197	313	95	499	607	145	829	937	195	1187	1607	
46	199	773	96	503	631	146	839	1163	196	1193	1429	
47	211	607	97	509	733	147	853	919	197	1201	2239	
48	223	313	98	521	757	148	857	911	198	1213	2381	
49	227	383	99	523	877	149	859	1187	199	1217	2011	

Stephen R. Richards, A5235

APPENDIX 1; from Chapter 2, Page 11

Euclid's proof that the number of primes is infinite involves numbers of the form

$$(1 \times 2 \times 3 \times 5 \times 7 \times 11 \times \cdots \times N) + 1$$

where the part in brackets contains all the primes up to and including N (which is also a prime). Euclid's argument was that this number could not be exactly divisible by any prime up to and including N (since division by any of these always produces the remainder 1), so that it must either be a new and larger prime number itself, or be divisible by a prime larger than N. Here we discuss the question of how often the number set out above is itself prime. Surprisingly, perhaps, very few are once we get beyond the smallest examples $N=2$, 3, 5, 7, and 11. In fact, after $N=11$, only four more of these so-called *Euclidean* primes exist up to $N=1031$; they are for $N=31$, 379, 1019, and 1021. In view of the comparative rarity of these special types of prime, the occurrence of a pair of twin-primes just beyond 1000 in the series for N is a delightful surprise.

Recently, anthropologist Reo Fortune has suggested that if P is the smallest prime number which is strictly greater than any particular (prime or non-prime) Euclidean number of the above form, then the number defined by

$$P - (1 \times 2 \times 3 \times 5 \times 7 \times 11 \times \cdots \times N)$$

is *always* prime. To illustrate this, consider the number

$$1 \times 2 \times 3 \times 5 \times 7 \times 11 \times 13 \times 17 = 510{,}510.$$

The next prime larger than the corresponding Euclidean number 510,511 is 510,529. The 'fortunate number' for this case is therefore 510,529 − 510510 = 19 and it is prime. The complete sequence of 'fortunate numbers' begins

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2, 3, 5, 7, 13, 23, 17, 19, 23, 37, 61, ...

and to date all such numbers which have been tested are prime, although no general proof of Fortune's conjecture has been given.

Also see Robe p 63-4.