regular rehydration even after heating could be taken as evidence for presence of interlayered material or some other imperfection. Control of humidity makes diffraction studies independent of atmospheric conditions and offers the possibility of more accurate and definite results.

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COMPUTER PROGRAM FOR NORM CALCULATION

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A program written for the IBM 650 digital computer permits the calculation of the norm of igneous rocks by the molecular norm method of Barth (1931, 1955).

A flow diagram[3] was first prepared outlining the step-by-step procedure. This formed the basis for the symbolic optimum assembly program which consists of (1) a program deck containing the instructions for the computer and the equivalent molecular weights for SiO_2, $AlO_{3/2}$, $FeO_{3/2}$, FeO, MgO, CaO, $NaO_{1/2}$, $KO_{1/2}$, TiO, MnO, $PO_{5/2}$, CO_2, S, H_2O-, H_2O+; and (2) a set of three data cards containing the chemical analysis of each of the rocks to be computed.

Once the program has been put into the computer, any number of analyses may be supplied for recasting to the norm. The saving in time over hand calculation is considerable. The actual machine time for the calculation, from start to punchout, averages six seconds per analysis. The results of the calculations consist of the percentages of the cations used in the calculation and the percentages of the normative minerals. They are punched out in a series of five cards which can be printed out as desired. The computer states the results in eight figures, using the floating decimal system. These figures must, however, be rounded off.

Although originally designed to deal only with analyses of relatively unaltered rocks, the program is flexible and can be adjusted to handle

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[3] A small supply of copies of the flow diagram is available. A copy may be obtained from the senior author.

analyses of altered rocks as well. Preliminary examination of a thin section of the analyzed rock will determine whether or not alteration has occurred. If so, constituent oxides other than H_2O (CO_2, for example) can be eliminated from the computation. If such deletion is necessary it can be made at the time the data cards are prepared, or it may be accomplished with the computer with the use of a modified program deck.

Comparison of Results

In order to test the program, results obtained by the computer were compared with published norms for a number of chemical analyses of volcanic and plutonic rocks covering a full range of composition. In addition, the machine and hand calculated norms of more than 50 new analyses of calc alkaline rocks from a suite of volcanic and associated plutonic rocks were compared. In each case, the hand calculation was done by at least two, and in most instances three, individuals. Table 1, which presents the chemical analyses and hand calculated molecular norms of four igneous rocks (Sun and Baldwin, 1958, p. 44 and 54) and our machine calculated norms demonstrates the extent of agreement which we encountered in our tests. Identical data, constants, and sequence of arithmetical operations were used in both the hand and computer calculations. The discrepancies in the two sets of figures are the result of differences in the number of places used in the calculation; four significant figures were used in the hand calculation and eight in the floating decimal system of the computer. This may give rise to differences of 0.01 per cent at any point in the calculations. A difference of 0.01 per cent in an early stage of operation may, by multiplication, result in discrepancies of the order of 0.05 per cent. This is the case for the normative albite and normative anorthite percentages for the glassy latite in Table 1.

Computer programs of the C.I.P.W. weight method of norm calculation have been presented by Thornton and McIntyre (1958) and Johnson (1962). The relative advantages of the molecular norm method (Barth, 1962; Sun and Baldwin, 1958; Eskola, 1954) encouraged us to write the above program. Although both types of norm calculation programs, the molecular norm method described in this paper and the weight norm method referred to above, are very rapid and the results are capable of duplication, they are still subject to errors in punching the chemical data on the cards. Nevertheless, they should prove invaluable for reexamining large numbers of norm calculations from past publications and for the ready handling of the large numbers of analyses which will be supplied as a result of the continued development of methods for rapid chemical analysis.

TABLE 1. CHEMICAL ANALYSES AND MOLECULAR NORMATIVE MINERAL VALUES
(Sun and Baldwin, 1958, p. 44 and 54)

Chemical Analyses

	Glassy Latite	Andesite Breccia	Calcic Latite	Olivine Basalt
SiO_2	65.16	58.43	55.12	45.81
Al_2O_3	16.34	17.28	17.18	14.08
Fe_2O_3	3.45	4.36	7.45	5.21
FeO	0.50	1.55	1.22	7.41
MgO	0.47	1.81	1.79	8.79
CaO	3.20	6.28	6.50	9.45
Na_2O	4.65	3.91	4.07	2.49
K_2O	3.62	2.19	3.78	0.86
H_2O+	1.20	1.05	1.69	2.43
H_2O-	0.33	1.60	0.22	0.43
CO_2				0.88
TiO_2	0.54	0.62	0.84	1.63
P_2O_5	0.15	0.34	0.52	0.28
MnO	0.07	Tr.	0.08	0.19
Total	99.68	99.42	100.46	99.94

Molecular Normative Values

	Hand Calculated	Computer	Hand Calculated	Computer	Hand Calculated	Computer	Hand Calculated	Computer
Quartz	16.54	16.573	12.87	12.861	4.09	4.093	—	—
Orthoclase	21.85	21.828	13.45	13.44	22.85	22.859	5.25	5.25
Albite	42.65	42.60	36.45	36.462	37.40	37.396	23.10	23.094
Anorthite	13.25	13.30	24.05	24.042	17.86	17.866	25.53	25.532
Wollastonite	0.78	0.762	2.38	2.409	4.70	4.668	—	—
Enstatite	1.32	1.324	5.20	5.191	5.06	5.058	—	—
Diopside	—	—	—	—	—	—	12.20	12.22
Hypersthene	—	—	—	—	—	—	17.02	16.999
Olivine	—	—	—	—	—	—	6.03	6.024
Magnetite	0.24	0.202	2.40	2.396	1.29	1.298	5.62	5.628
Hematite	2.29	2.32	1.55	1.56	4.46	4.449	—	—
Ilmenite	0.76	0.768	0.90	0.897	1.20	1.197	2.34	2.346
Apatite	0.32	0.32	0.75	0.739	1.09	1.113	0.61	0.605
Calcite	—	—	—	—	—	—	2.30	2.30
Total	100.00	99.997	100.00	99.997	100.00	99.997	100.00	99 997

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STILPNOMELANE AND SPESSARTITE-GROSSULARITE FROM FRANKLIN, NEW JERSEY[1]

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Stilpnomelane

Stilpnomelane occurs at Franklin as thin coatings upon crystals of dolomite and pale green sphalerite in hydrothermal veinlets that locally cut the main orebody. Specimens are contained in many collections of Franklin minerals, where they are usually found labelled chlorite. A chemical analysis is cited in Table 1. It yields a total of 8 Si atoms in the talc-layer of the structure when calculated on the basis of 30 (O, OH) ions, and thus conforms to the interpretation of the composition of this

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