October 9, 1953.

Dear Dr. Meyer :

This is only a short note written in the last-minute hurry that you can imagine (or can you ?). The equipment has been sent to New York for shipment to Santos and Sao Paulo, with the address: K.S., Dept. de Fisica, Univ. de Sao Paulo, Caixa Postal 8105, Sao Paulo, Brasil -the best approximation I could find. A packing list -again the best approximation available to a complete list of all material and equipment shipped- is enclosed.

Looking forward to meeting you soon, I am

yours very sincerely

Kurt Sitte

(COPIA)

Outline of Research Work Planned for São Paulo, 1953/55.

Two major experiments (or groups of experiments) are suggested, both concerned with problems of nuclear interactions of cosmic ray particles. - While in the opinion of the writer nuclear physics is only one of the three main aspects of cosmic ray physics, its further exploration at this stage is not only of interest in itself, but also imperative for our understanding of the other two -astrophysics and atmospheric physics- which may well soon become of primary importance.

The Syracuse group has recently carried out a series of air shower experiments based on the idea to make the electron component a monitor for study of high-energy nuclear collisions. Only a small part of the results has been reported (Phys. Rev. 87, 351 (1952); Bull.Am.Phys.Soc. 28, Nº 1, 32 , - (1953), but the analysis of the rest is now nearly completed. These experiments employed a technique used also in previous work of the Syracuse group, combining a large cloud chamber and a hodoscope of well over 100 counters . They were carried out partly at Echo Lake (alt. 3260m) and partly at Mt.Evans (alt. 4300m) in Colorado.

It is felt that for a full understanding of the complex phenomenon of air showers experiments at other altitudes would be highly useful. This is easily seen if one recalls that a correct theory of the electron component of air showers must take in account two basic effects : the initial distribution of the electron-producing particles ejected in the primary collision, and a "source function" of continuing replenishment of the electronic component derived from the accompanying nuclear cascade. Hence, no unique interpretation can be obtained from observations at a single altitude (for brevity, this argument is of course put here in a very simplified form). Continuation in a somewhat modified version of the recent experiments at two more altitudes: Sao Paulo and Chacaltaya, is therefore of considrable interest.

By adding a number of liquid scitilators to the arrangement, and by proper rearrangement of its parts, the air shower experiment can be made to study simultaneously also another important phenomenon directly connected - with the "Source function". It is known that at "low" energies (20 Bev) about 1/3 of all mesons are of the -variety which is the only known major source of the electronic component. If, however, at higher primary energies only about one-half of the energy available for meson production goes into the -compnnent, and the rest into the heavier K-particles, then the electron component -unless there is another unknown neutral particle also produced whose decay products yield more electrons should comprise at these energies a smaller fraction of the primary energy, and a larger fraction should be diverted into the nucleonic and -meson components. This seems to be in contradiction with the observed composition of air showers, which would demand a ratio of -mesons to charged secondaries rather larger than 0.5 . Consequently, a neutral particle of mass about equal to that of the k-mesons appears likely as a further "electron source", and the experiment has been designed so as to investigate "local" interactions of energies between 10 and 100 Bev as well as air showers.

The second experiment is concerned with the "transparency" effect of light nuclei. It is the writer's opinion (Acta Phys. Austr. 6, 167 (1952); Bull. Am. Phys. Soc. 27, Nº 4, 21 (1952)) that both the experimental evidence and the theoretical interpretation hitherto given are unsatisfactory and insufficient. The first employs techniques not discriminative enough to yield clean results, and the second neglects higher-genetation effects and therefore variations in the primary energies compared. Since the rransparency effect is intinately connected with the interaction mean free path in nuclear matter, that is, with the "collision volume" of nucleon-nucleon interactions, the knowledge of its correct value is of considerable interest.- The experiment planned for this study uses Geiger and scintillation counters, and will be connected with a check on the altitude dependence of showers of various complexity (and hence of various primary energy). Because of the high geomagnetic cutoff, this latter study will also gibe data on the atmospheric transition effect of the shower primaries as a function of their energies.

In conclusion, it should be emphasized that this outline is purely tentative. At this stage, the writer considers the experiments described above as both suitable and feasible, but in a field of so rapidly growing knowledge and so sudden new developments an exact detailed plan for years ahead cannot and should not be made. A great deal of effort should be directed towards equipping the laboratory with all-purpose standard equipment which can be readly employed for a wide variety of experiments : fast coincidence circuits, discriminators and pulse-shaping units, anticoincidence arrangements and similar basic tools of particle research. Expenditure related to this phase of the work is listed both under I (b) "Construction", and together with standard test equipment under III.

a) Kurt Sitte,
Department of Physics,
Syracuse University,
Syracuse 10, New York.

I. Cloud chamber - Hodoscope - Scintillation counter Experiment to Study Structure and Composition of Air Showers and of High-Energy Interaction.

Cloud chamber, hodoscope, scintillator, and associated circuits will be brought from Syracuse, but replicas will be constructed. Geiger counters will have to be purchased or manufactured. The experiment will be carried outh both at Sao Paulo and at Chacaltaya.

Expenditure : (a) Running Expenses.

(1) Equipment and Supplies.

Counters	$ 5,000.00		
Parts and components (replacements)	600.00		
Photographic materials	500.00		
Absorber materials &c	400.00		
Total	$ 6,500.00	$	6,500.00

(2) Travel, Power, Miscellaneous.

Transportation of equipment (est'd)	$ 2,000.00		
Travel expenses (est'd)	1,000.00		
Power, fuel &c (Chacaltaya)	300.00		
Extras (services, emergencies)	500.00		
Total	3,800.00	$	3,800.00

(b) Construction.

(1) Cloud Chamber.

Body materials	$ 800.00		
Pneumatic system	500.00		
Illumination system	1,000.00		
Camera	200.00		
Small parts, materials	500.00		
Control system	200.00		
Total	$ 3,200.00	$	3,200.00

(2) Associated Circuits.

Counter trays (preamplifiers)	$ 400.00		
Control circuits	200.00		
Hodoscope panels	400.00		
Power supplies	600.00		
High voltage supplies	100.00		
Test circuits	300.00		
Parts and components	300.00		
Total	2,300.00	$	2,300.00

Total Expenditure "Experiment I" ..... $ 15,800.00

II. Counter - Scintillator Experiment on "Transparency Effect".

Equipment will be constructed at Sao Paulo. The experiment will be run mostly at Sao Paulo, but probably also for a shorter periodo at other stations (Chacaltaya, possibly Santos).

Expenditure :

(1) Equipment and Supplies.

Counters (new and refilled)	$ 3,600.00	
Electronic supplies	600.00	
Photographic supplies	300.00	
Materials (construction, absorber)....	200.00	
Camera	100.00	
Auxiliary equipment	100.00	
Extras	200.00	
Total	$ 5,100.00	$ 5,100.00

(2) Miscellaneous.

Transportation of equipment (est'd)..	$ 500.00	
Power, fuel &c (Chacaltaya)	200.00	
Travel expenses	1,000.00	
Emergencies	300.00	
Total	2,000.00	$ 2,000.00

Total Expenditure "Experiment II" ..... $ 7,100.00

III. General Equipment.

(1) Test Equipment [+].

1 Cathode Ray Oscilloscope Tektronix Type 512	$ 950.00	
1 Cathode Ray Oscilloscope Dumont Type 303A	900.00	
1 Double Pulse Generator Berkeley Model 903	450.00	
1 Nuclear Instruments Scaler M. 162.	535.00	
1 Atomic Instruments Linear Amplifier Model 204B	450.00	
1 Atomic Instruments Pulse Height Analyser Model 510	695.00	
Total	$ 3,970.00	$ 3,970.00

(2) Parts, Components, Units.

Electronic supplies (assorted)	$ 1,000.00	
Tubes	400.00	
Parts (relays, sockets &c)	300.00	
Binary scalers (GE nº 4SN1A2)	130.00	
RF supplies	200.00	
Materials and tools	100.00	
Coax cable &c	300.00	
Total	2,430.00	$ 2,430.00

Total Expenditure "General Equipment" ..... $ 6,400.00

Summary :

"Experiment I"	$ 15,800.00
"Experiment II"	7,100.00
"General Equipment"	6,400.00
Total	$ 29,300.00

+) Manufactures and models are quoted only as indication of the type of instrument suggested, but in general they can be replaced by other similar models.