IL.10 (Suitland 326-79-8, Box 15)

LINDSAY LIGHT & CHEMICAL COMPANY

WEST CHICAGO, ILLINOIS

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2112 Shepherd St., N.E.
Washington 18, D. C.
January 1, 1951

Mr. E. J. Lintner
Munitions Board
The Pentagon
Washington, D. C.

Dear Mr. Lintner:

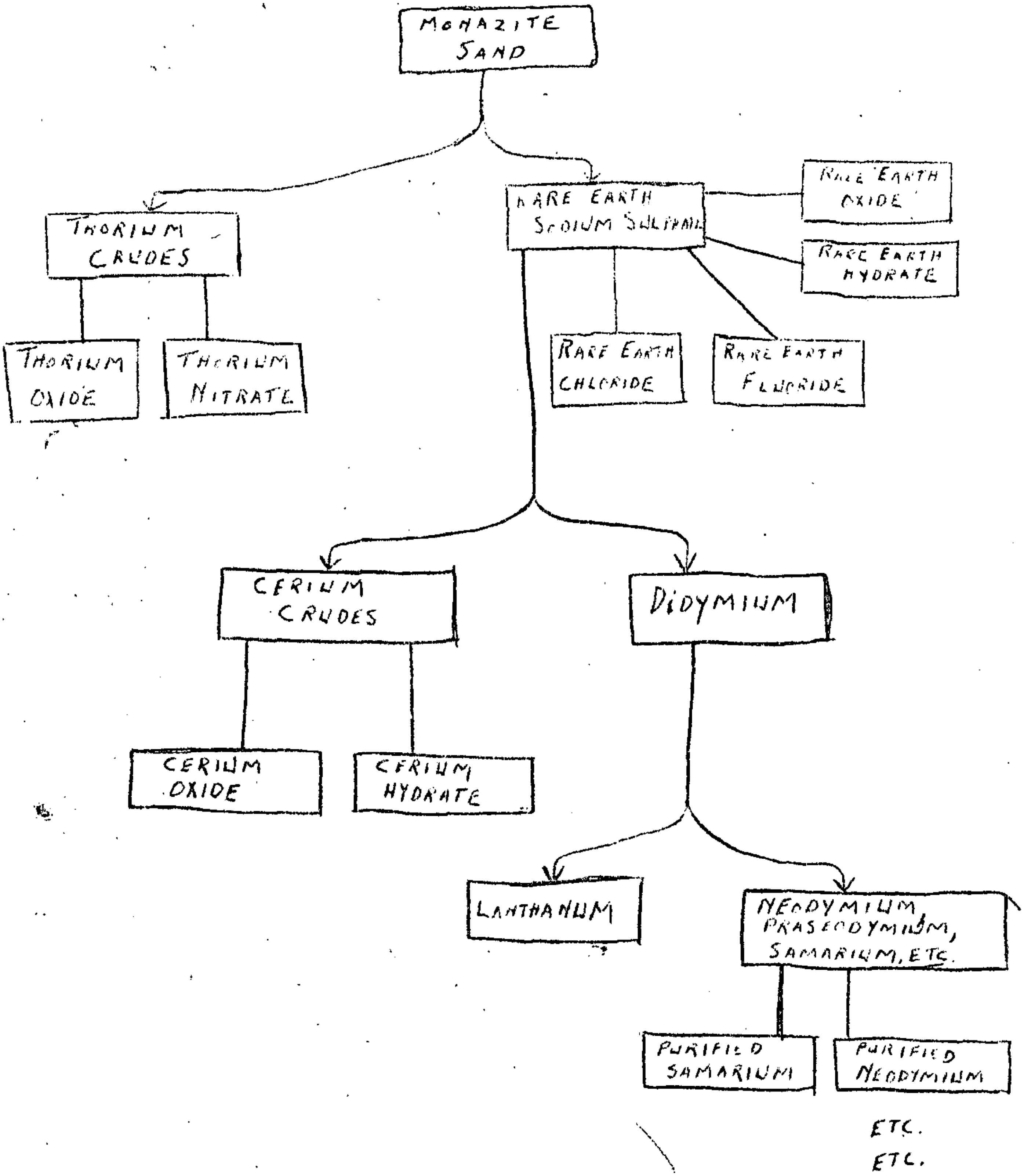
Pursuant to your verbal request during our meeting a couple of weeks ago, I will try herein to answer some of the questions brought out relative to our chemical processing of monazite sand, our present plant capacity, our customers, whose end use of rare earth products is possibly strategic, and, finally, information relative to monazite and bastnaesite in general.

In regard to our chemical process, the following layman explanation is sufficient to get a workable knowledge of our plant operation. The initial break-up of monazite sand with acid yields a crude thorium on the one side and a crude rare earth sodium sulphate on the other side. The crude rare earth sodium sulphate contains all the rare earth elements in combination. The crude thorium is worked through a number of steps to produce a purified thorium nitrate or thorium oxide. Starting with the crude rare earth sodium sulphate as the base material, it can be treated with various acids, depending on which crude rare earth compound is desired, to produce rare earth fluoride, rare earth oxide, rare earth chloride, etc. Each of these rare earth products still contains all the rare earth elements. Again starting with crude rare earth sodium sulphate as the base material, it can be chemically processed to split so that the cerium in a crude form will come off one side and didymium on the other side. To obtain purified cerium products, the cerium material which has come off one side is purified by various methods. Starting with the didymium as the base material, it can be chemically processed to split so that lanthanum will come off on one side and neodymium, praseodymium, samarium and other rare earth elements of higher atomic numbers will come off the other side. Using the last-named material as base material, further chemical processing will produce the purified rare earth elements one by one.

To illustrate the above-written explanation, I have drawn the following chart which you may find helpful:

(See next page)

JCJ
RLF
23203FWM
FFW


MONAZITE SAND
THORIUM CRUDES
RARE EARTH SODIUM SULPHA
RARE EARTH OXIDE
RARE EARTH HYDRATE
THORIUM OXIDE
THORIUM NITRATE
RARE EARTH CHLORIDE
RARE EARTH FLUORIDE
CERIUM CRUDES
DIDYMIUM
CERIUM OXIDE
CERIUM HYDRATE
LANTHANUM
NEODYMIUM, PRASEODYMIUM, SAMARIUM, ETC.
PURIFIED SAMARIUM
PURIFIED NEODYMIUM
ETC.
ETC.

23203

We are presently processing approximately 200 metric tons of monazite sand per month, or 2,400 metric tons annually. This is our present capacity. Based on this present capacity of 2,400 metric tons of monazite per year, if all of the monazite was turned into rare earth chloride, we could obtain approximately 2,500 metric tons of rare earth chloride or slightly in excess of one ton chloride from one ton of sand.

Assuming we had all of the sand that we needed, assuming that we had all of the labor that we needed, and assuming that we could secure all necessary equipment and building material we needed, we figure that we could increase our present production approximately 25% within three months. This could be done probably by an interior rearrangement of our plant and would not require additional exterior building. Anything beyond this expansion would require an exterior addition to our plant, and we anticipate that it would take approximately one year to put in such a further expansion in operations. This could entail a 50, 100 or 200% expansion, but anything over a 25% interior expansion, as referred to at the beginning of this paragraph, would entail material additions to our water, sewerage, and power plant departments. We estimate that with our present land area, we could quite possibly double or triple our present production as we feel that it would be possible to put the necessary buildings, etc., on our present land.

We are presently dividing our production of rare earths in three parts - a third goes to rare earth chloride, a third to rare earth fluoride and rare earth oxide, and the balance of the remaining third is the base material for purified cerium products and other rare earth products (see chart). This same ratio would be present if we increased production unless everything was turned into, say, rare earth chloride or any of the other products. With regard to your question on how much chloride, oxide, and fluoride would be obtained from a pound of monazite, as explained above, our present yield is slightly over one pound chloride from one pound of monazite. Approximately one pound of fluoride would be obtained from two pounds of monazite, and about 1.2 pounds of oxide from three pounds of monazite.

With regard to analysis of Indian, Brasilian, Florida and Idaho monazite, all of the monazite from these localities, if sufficiently purified, will contain a minimum 60% rare earth oxide and assuming that this is the case, we would say that the Indian monazite would contain 60% rare earth oxide and 8% thorium oxide. The Brasilian monazite contains 60% rare earth oxide and 6% thorium oxide; the Florida monazite, 60% rare earth oxide and 4 to 5% thorium oxide; and the Idaho monazite, 60% rare earth oxide and 2½ to 3½% thorium oxide.

With regard to bastnaesite, a completely purified bastnaesite may analyze as high as 70% rare earth oxide although I doubt if it is going to be commercially feasible or possible to obtain a bastnaesite running higher than 45 to 50% rare earth oxide. The break-up of the rare earth oxide is composed of the following:

45.5% cerium oxide
1.3% samarium oxide
3.3% praseodymium oxide
8.5% neodymium oxide
41.4% lanthanum oxide and others

Bastnaesite will not contain more than one half of one percent thorium oxide.

You asked about processing bastnaesite. In answer we say, plenty sweat, blood and tears. However, we have been working on this on a pilot plant basis for the last six months, and we feel that once bastnaesite is rolling into our plant in commercial quantities, and if we had to begin processing bastnaesite because of inability To secure sufficient monazite for our needs, we would be in a position to jump into commercial production within three months.

I believe we agreed that rare earth chemicals can be classified as raw materials in the manufacture of other end products. Some of these end products may be classified as strategic and critical. For example, we sell rare earth chloride to four customers who produce rare earth misch metal. This metal is then sold to steel companies for steel manufacture and to other companies who make alloys for jet engines, etc. I believe we further agreed that for you to determine the needs for rare earth chemicals that you ought to contact some of our customers to determine their end products, the importance thereof and estimated quantities of rare earths necessary in an emergency.

I am listing the following customers; the rare earth product they purchase and estimated end use for your information. I am not listing the quantities sold to each customer as this information is confidential in a supplier-customer relationship. If you feel that that information is important to you, it is suggested that you procure it from each company listed hereunder.

RARE EARTH PRODUCT	CUSTOMER	END USE
Rare Earth Fluoride Rare Earth Oxide	National Carbon Division Union Carbide & Carbon Corp.	Arc Carbons
Rare Earth Chloride	Cerium Metals Corp. New Process Metals Corp. General Cerium Company Matchless Metals Corp.	Misch Metal
Cerium Oxide	Practically all optical companies	Polishing ophthalmic and precision lenses
Cerium Hydrate	Pittsburgh Plate Glass Co. Libby-Owens-Ford Glass Co. Corning Glass Works	Ingredient in optical glass and in coloring and decolorizing of glass
Didymium Carbonate	Globe-Union, Inc. Indiana Glass Co. Morgantown Glassware Guild	Electrical co-efficient in radio condensers and as a glass decolorizer
Lanthanum Ammonium Nitrate	General Electric Company, Hanford Works	We wish we knew
Ceric Ammonium Nitrate	General Electric Company, Hanford Works	As a scavenger in the production of explosives

(Continued)

RARE EARTH PRODUCT	CUSTOMER	END USE
Lanthanum Oxide	Eastman Kodak Company	As an ingredient in the production of aerial photographic lenses
Neodymium Oxalate	United States Glass Co.	Production of colored glass
Thorium Nitrate	The Coleman Company Aladdin Industries, Inc. U.S. Atomic Energy Commission	Production of Incandescent Mantles and possible partial substitute for Uranium in atomic energy
Thorium Oxide	Eastman Kodak Company Norton Company Raytheon Corporation	As an ingredient in the production of aerial photographic lenses. Also in the production of high temperature crucibles

I trust the above information will be of value.

Very truly yours,

JAMES S. MURRAY
Assistant to the President

JSM:mmm

CC: Chas. R. Lindsay, III
Mr. Jesse Johnson (A.E.C.) ✓
Mr. Jack Clark (Bureau of Mines)
Lt. Col. Paul Spahr (U.S. Air Corps.)