THE CYANIDE PROCESS IN NEW MEXICO.

By V. V. CLARK,
Bland, New Mexico.

With Plates I and II.

Owing to the very limited time afforded the writer in preparing this article, only the Cochiti Mining District will be considered and that very briefly. Nor will we attempt to give a technical discussion on the subject but will merely describe plainly the applications of the process in the Bland and Albemarle mills in this district.

The ores of the district are those generally termed in milling "refractory." They occur in quartz in the form of sulphides, tellurides, antimonides and arsenides,—the latter only in small quantities. The tellurides occur as petzite and sylvanite, the antimonides as stephanite and the arsenides apparently in mechanical combination with argentite. Free gold occurs in pure white quartz but in an exremely fine state of division. The proportion of silver to gold is variable but as a rule the gold values remain constant. Knowing the composition of these Cochiti ores it can be readily seen why they yielded an unsatisfactory extraction to the amalgamation and chlorination processes which were tried during the early days of the district. It was then that the Bland mill was built which successively tried the processes above mentioned, even combining the Russell-hyposulphite-of-soda leaching process with pan-almalgamation which resulted in the recovery of a small percentage of the silver and but an unsatisfactory portion of the gold.

It was at this juncture that the Pelatan-Clerici-electro-cyanide process was recommended and tried. The writer became connected with the Bland Mill during the installation of this process, and watched with interest its success in overcoming

In the black lime and the Flint Ridge above it, the specimens are relatively small but cannot be otherwise distinguished.

*19. *Spirifer opimus* Hall.

There are a number of specimens which seem to agree with S. opimus in the limestone below the shale as well as in still higher horizons but we cannot be certain that they are not the young or small forms of S. striatus with which they are associated.

20. *Spirifer fultonensis* Meek?

21. *Rynchonella* sp.

LAMELLIBRANCHIATA.

*22. *Astartella newberryi* Meek.

*23. *Astartella varica* McChesney.

*24. *Aviculopecten scalaris* Herrick.

*25. *Aviculopecten occidentalis* Win? A large species is represented by mere fragments.

*26. *Crenipecten foersti* Herrick.

*27. *Lima retifera* Shumard.

28. *Edmondia nebrascensis* Geiniz?

29. *Macrodon carbonaria* Con.

HETEROPODA.

*30. *Bellerophon crassus* M. and W. (?)

PTEROPODA.

31. *Conularia* sp.

CRUSTACEA.

32. *Phillipsia* sp.

A small trilobite is represented by pygidia alone and although it is undoubtedly new it does not seem to us desirable to name forms in this genus upon pygidial characters only.

the refractory bases mentioned and in yielding a satisfactory extraction of values.

The Pelatan-Clerici process is a product of French ingenuity, being a combination of cyanide, electricity, agitation and amalgamation. What one extractor fails to get the other catches, thus making it especially adapted for refractory ores. Even talcose ores and slimes are successfully treated with this process. In fact, the finer the ore is ground the better will be the extraction. A brief description of the process is as follows: The tanks are nine feet in diameter with staves four feet six inches high. On the bottom of the tank is a copper plate, flared on the side leaving a space of about one inch between the flare and the inside circumference of the tank. This space is filled with Portland cement. This plate is called the "cathode," and on it is spread about one-eighth inch of mercury. Suspended in the tank from timber work above is an agitator, consisting of a vertical steel shaft having a hub at the bottom from which radiate eight cast iron arms fitted with wooden paddles and brace rods. These arms are called the "anodes." Electrical connections are made with the cathodes and anodes from a low voltage dynamo. The agitator revolves only fourteen times per minute. In operating these tanks a sludge of about equal portions of water and crushed ore is introduced by means of launders leading from the settling tanks above. The manufacturers recommend only two and one-half tons of dry ore per charge. A tank can be crowded however to hold four tons, but it takes more time to treat a charge under these conditions. After the sludge is charged, the agitator being in motion, salt is added to perfect the electrical condition between the anodes and cathode. A certain amount of slacked quicklime is then introduced to destroy the acidity in the ore. Potassium cyanide is then added in scheduled quantities after which steam is turned on through connections at the side of the tank, for the purpose of oxidation and heating the sludge, as hot solutions yield a better extraction than cold.

Theoretically, the cyanide solution, assisted by the agitation, brings the gold and silver into solution, after which the

current of electricity decomposes the auro-argentic-potassic-cyanides thus formed, liberating and precipitating the precious metals in a metalic form in the mercury bath on the cathode. A charge is generally agitated from eight to twelve hours according to its bulk, when a valve at the side of the tank is opened and the sludge allowed to run out. The tank is then ready for another charge.

About every fifteen days the tanks are "cleaned-up." This is very much like a clean-up in a pan-amalgamation mill. The hard amalgam is carefully scraped off the cathode while the soft amalgam, "raw-quick" etc., pass into a clean-up pan, which is also provided with an agitator. From there the mercury and soft amalgam is drawn into a canvas strainer. The hard and soft amalgams are then placed in a retort, the crude bullion resulting therefrom being refined in large graphite crucibles in a coke smelting furnace, and molded into the usual bars.

We will now follow the ore in its successive stages of treatment through the Bland mill. Beginning at the storage bins, the ore is fed direct to a Gates crusher which reduces it to about the size of a hickory nut. From the crusher it drops into another storage bin, thence into two ore feeders which feed a battery of ten stamps. Each stamp weighs eight hundred and fifty pounds and drops ninety-six times per minute. The ore is stamped wet, passing through a sixty-mesh screen. The sludge from the battery passes through a launder to a series of eight rectangular settling tanks, where the sands are settled on the "hydraulic-race" principle. The excess of clear solution coming from the last of these tanks is forced by a steam jet into a storage tank above the battery. Below the settling tanks are located three Pelatan-Clerici tanks. The tailings from these tanks pass over Wilfley and Johnston concentrators and from thence to three circular settling tanks in which the cyanide solution is saved by decantation. This solution flows in a sump tank from whence it is pumped into the storage tank above the battery and used over again. The settled tailings after the solution is drawn off are discharged outside the mill in the creek. It is to be noted that the entire mill is built on the gavity sys-

tem, thus requiring very few workmen for its operation. The writer has enjoyed extensive experimentation with the Pelatan-Clerici process while in charge of this mill, accumulating much valuable and interesting data. The insertion of these data is, however, beyond the limits of this article.

The Albemarle mill of the Cochiti Gold Mining Co. has a capacity of ten thousand tons per month and is as fine a cyanide plant as can be found in the United States. Here the main bulk of the ore is treated by the McArthur and Forrest cyanide leaching process, while the fines and slimes are treated with the Pelatan-Clerici process. The leaching department consists of eight square iron tanks holding one hundred and eighty tons each, twelve round iron tanks each of a capacity of one hundred and twenty tons and six round wooden tanks holding seventy tons each. The Pelatan-Clerici department is equipped with eight Pelatan tanks which are operated on essentially the same lines as at the Bland mill.

In the crushing department the ore passes from two 10 by 16 Blake crushers into storage bins beneath and from thence into feeders to the coarse rolls. From the coarse rolls the reduced ore drops into the boot of an elevator which discharges onto coarse screens, the product dropping into two hoppers which automatically feed two large revolving dryers. From the dryers the ore passes six sets of Davis and Allis finishing rolls, the pulp then being screened through twenty four mesh revolving screens. That which passes the screens falls into a storage bin from whence it is trammed to the leaching tanks. The reject on the screens returns to the finishing rolls for finer grinding. A 36 in. suction fan relieves the mill of all dust. This dust is treated in the Pelatan-Clerici tanks. Two Huntington-Mills operate on all talc and screenings from a grizzley, which product is also treated in the Pelatan-Clerici department.

In the leaching department all tanks are equipped with the latest and best filter bottoms, the discharge gates in all but the seventy ton tanks being in the bottom. After a tank has been charged with dry ore, the cyanide solution is turned on from both top and bottom and the charge thoroughly saturated. The

solution is piped from iron storage tanks, five in number, each holding twenty eight tons of solution. The solution is heated by means of steam in these storage tanks to about a hundred and fifty degrees Fahr. After saturation the charge is treated several times per day with measured quantities of the cyanide solution. This treatment continues from eight to ten days, depending mainly upon the rate of percolation and temperature of the solutions. Washwater is then applied in measured quantities, after which the charge is thoroughly drained with a vacuum pump. The assays of the preliminary tailings being satisfactory, samples of the final tailings are taken and the charge is sluiced out.

The cyanide solution, passing as it does constantly through the various tanks and charged more or less with gold and silver values, is piped to a series of five sump tanks from whence it is pumped to the precipitation room. Here are located fourteen sets of zinc boxes, four boxes in each set which are filled with zinc shavings. The values in solution are precipitated on these shavings as a black slimy precipitate. The shavings are cut automatically by means of a lathe to a thickness of one-twelve-hundredths of an inch. Every six days these boxes are cleaned up, the method being as follows: The boxes are made of sheet iron and of special construction, each box in the set of four being separate from the others and is equipped with handles for carrying. The boxes are taken to a rectangular wooden vat which is provided with filter cloths and filled nearly to the top with water. The contents of each box is screened through a ten-mesh screen in this vat of water, the shavings that remain on the screen being replaced in the box which is then filled with fresh shavings and removed to its section. This screening is repeated with all the boxes, after which the water is filtered off, the gold and silver slimes remaining in the vat on the filter-cloth. After thorough draining the slimes are treated with sulphuric acid in rectangular tile tubs for the purpose of destroying all fine zinc that may have passed through the screens. This insures a higher grade of bullion. After acid treatment the product is again run into the filtering vat and the mass

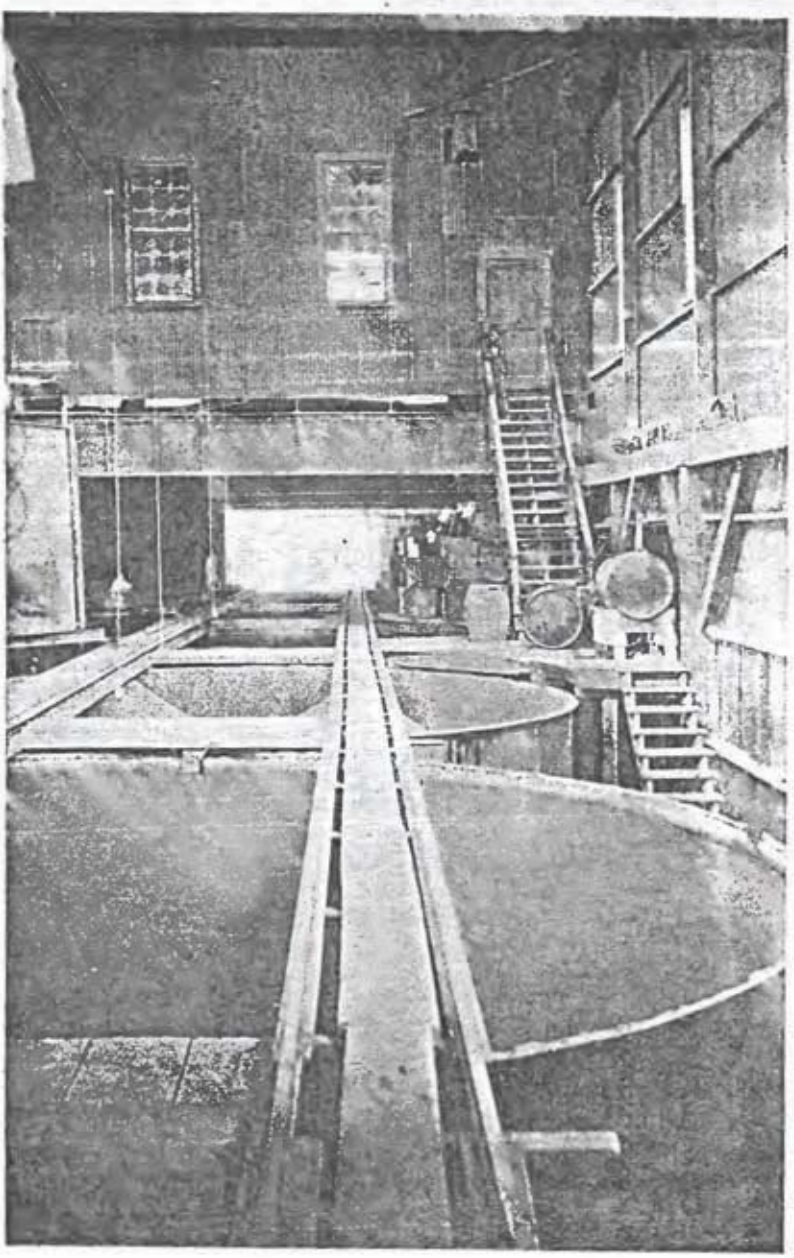
thoroughly washed for several days to remove all soluble sulphates. When thoroughly washed the product is dried in ovens, after which it is mixed with the proper fluxes and smelted into bullion in graphite crucibles in a coke furnace and molded into cones. These cones are afterward refined in the same furnace and molded into the usual rectangular bars.

It was during the period that the writer had charge of the Albemarle mill that he investigated closely the relative merits of the two cyanide processes just described. It resulted in the opinion that it was cheaper to operate both processes together as in the Albemarle mill, than singly. Even with the aid of a vacuum pump it is impossible to satisfactorily leach cyanide solutions through slimes, and for this reason if it were not not the Pelatan Clerici process, the Albemarle mill would experience considerable loss by depending upon the McArthur-Forrest process alone. On the other hand in operating the Pelatan-Clerici process alone, considerable expense is entailed in furnishing power for the agitation. For these reasons it can be seen how the two processes work in harmony with each other.

While we are not at liberty to give ore values, percentages of extraction etc., of the two mills just described, we can vouch for the success of the process on these Cochiti ores, which are without doubt the most refractory in the Territory.

FIG. 1. SMELTING BULLION AT THE BLAND MILL.

FIG. 2. CRUSHING DEPARTMENT OF THE ALBEMARLE MILL.



LEACHING TANKS IN THE ALBEMARLE MILL.