Studies of mechanical mining in bituminous-coal mines were continued, with particular emphasis on the extraction of pillars with mechanical equipment and the effect of the introduction of this equipment on percentage of recovery of coal. Data on mechanized mining and actual percentage of recovery at a number of mines are being correlated for publication.

A study of coal-mining methods and practices and electrical power demands in the Missouri River Basin was begun this year, and an investigation of coal mining in the Bull Mountain field, south central Montana, was completed.

Coal Mining in Europe

The conditions and methods used in mining coal in several European countries were studied by a representative of the Bureau to obtain accurate ideas of methods to be considered in improving those of American mines and to find ways to increase European production. Published reports indicate that Spanish resources are sufficient for that country's requirements; but production is restricted by lack of miners, equipment and power and by Government policy;27/ Italian resources are inadequate, and production has not met requirements;28/ in other countries the situation is changing, but details of production and resources are presented.29/

Mining of Coal for Local Use in Arctic Regions of Alaska

In connection with development of coal deposits near Government schools, hospitals, and villages in the Arctic regions of Alaska, a reconnaissance was made of a number of deposits.30/

The construction of frame houses in recent years, instead of the use of the conventional sod hut (igloo), by the Eskimos in the villages along the Arctic Ocean has increased the demand for fuel in these villages. The frame houses, which are not insulated against extreme cold and are difficult to heat, are equipped with coal stoves. The lack of development of coal deposits in the Arctic has made it necessary to import coal from the States by boat at high cost.

It was concluded from investigations of coal deposits in the vicinity of Deering, Point Lay, and Wainwright (fig. 13) that plans for mining coal in the Arctic regions of Alaska for native villages should be based upon natural conditions of the coal beds; climatic conditions, that is, freezing and thawing; short winter hauls by land; summer long hauls by water; reduction of present cost of coal; native ability; native economy; shortage of timber and proper supervision. Two plans can be followed: The first would be the development of local sources of coal at points nearest each village or group of villages; the second is the development of one source of coal, the transportation of coal to a stock pile on the Arctic coast, and transportation of this coal by barge to the various villages when the Arctic Ocean is free of ice along the shore.

27/ East, J. H., Jr., Information on Coal Mining in Spain: Bureau of Mines Inf. Circ. 7396, 1947, 27 pp.

28/ East, J. H., Jr., Italy's Coal Quandary - Dire Need, Diverse Effect: Foreign Commerce Weekly, vol. 26, No. 7, Feb. 15, 1947, pp. 67, 25, 26.

29/ East, J. H., Jr., The European Coal Situation: Mines Mag., vol. 36, No. 4, April 1946.

30/ Toenges, Albert L., and Jolley, Theodore R., Investigation of Coal Deposits for Local Use in the Arctic Regions of Alaska, and Proposed Mine Development: Bureau of Mines Rept. of Investigations 4150, 1947, 19 pp.

Bituminous coal in a deposit on the Kukpowruk River (fig. 14), approximately 45 miles upstream from Point Lay (about 35 air miles S. 20° E.), does not show degradation after long exposure to the weather. As the coal can be transported long distances with little or no degradation, this area may be considered under the second plan.

Development of Anthracite-Mining Machinery

A loading machine designed and built by the Bureau to solve the problem of transportation delays in mechanizing development work in thin, steeply pitching anthracite beds was modified by redesign and reconstruction of the front and rear drive-trough-support assemblies and replacement of the sleeve-type bearings by roller-type. Other minor changes were made to minimize spillage of fines around the machine, and plans have been carried out to electrify the scraper-end interchangeably with the original air-motor drive. The machine is shown in figure 16.

The principle of planing friable or crushed coal beds was demonstrated by Germany's wartime development of a rigid-blade planer. For planing anthracite or hard bituminous coals, the Bureau has undertaken the design and manufacture of a vibrating-blade type. Design was 70 percent completed in fiscal year 1948.

The 9-hp. Eickhoff (vertical) shearing machine (fig. 15) and the 20-hp. Korfmann universal shearing machine proved so efficient that, after slight changes for better mobility that are under way now, these machines will be used for driving a trackless gangway and companion airway in a 10-foot bed pitching 85°. An engineering study of the mine where these compressed-air-powered machines are to be used showed that with these machines less compressed air is used per yard advance than has been used in hand mining; and that, to drive this development work by hand, will cost 40 percent more than to drive it by machine, equipment and operating costs included.

Mining of Thick-Bed Pillars in Anthracite

The Bureau of Mines is participating in the establishment of a mechanical mining system for removing 50-foot pillars in a relatively flat anthracite bed ranging in thickness from 24 to 28 feet. A working committee, consisting of colliery and central management officials and one Bureau engineer, has investigated top-slicing and back-filling methods in the zinc mines of New Jersey and hydraulic flushing of thick, flat anthracite beds in the Southern anthracite field of Pennsylvania. An engineering-cost study was initiated to determine the practicability of pneumatic back filling by using the Bureau's pneumatic packing machine, which was obtained from Germany a year ago.

In addition, the Bureau has completed contracts for purchasing two lightweight shearing machines from Germany for driving small openings into the pillars. The cooperating company has designed and is building a special remote-control loading machine for loading the coal to be cut by the Bureau's machine.

Anthracite-Flood Prevention

The flooding of active and abandoned anthracite mines in Pennsylvania was investigated by obtaining data on: (1) Anthracite reserves, (2) underground water pools, (3) barrier pillars, (4) the "buried valley" of the Susquehanna River, and

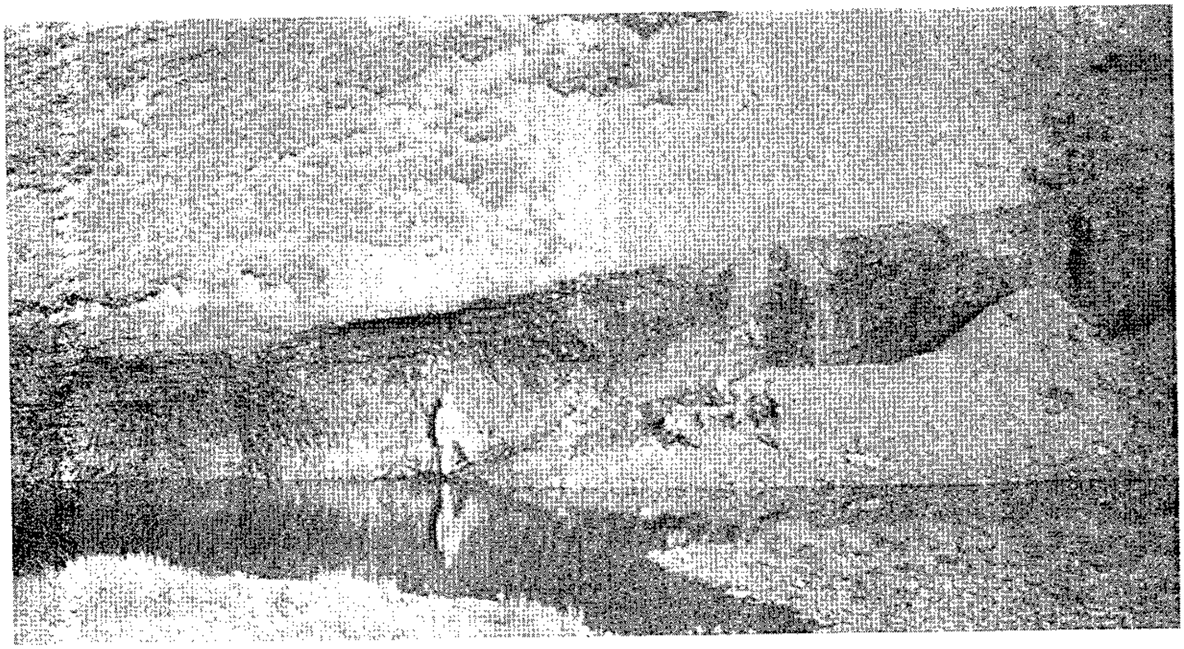

Figure 14. - Coal deposit on Kukpowruk River, approximately 45 miles upstream from Point Lay, Alaska.

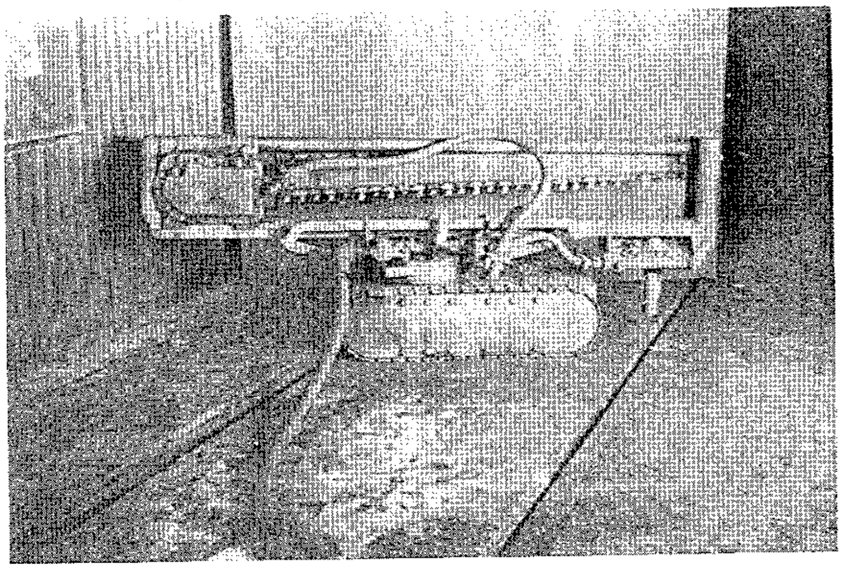

Figure 15. - Eickhoff shearing machine.

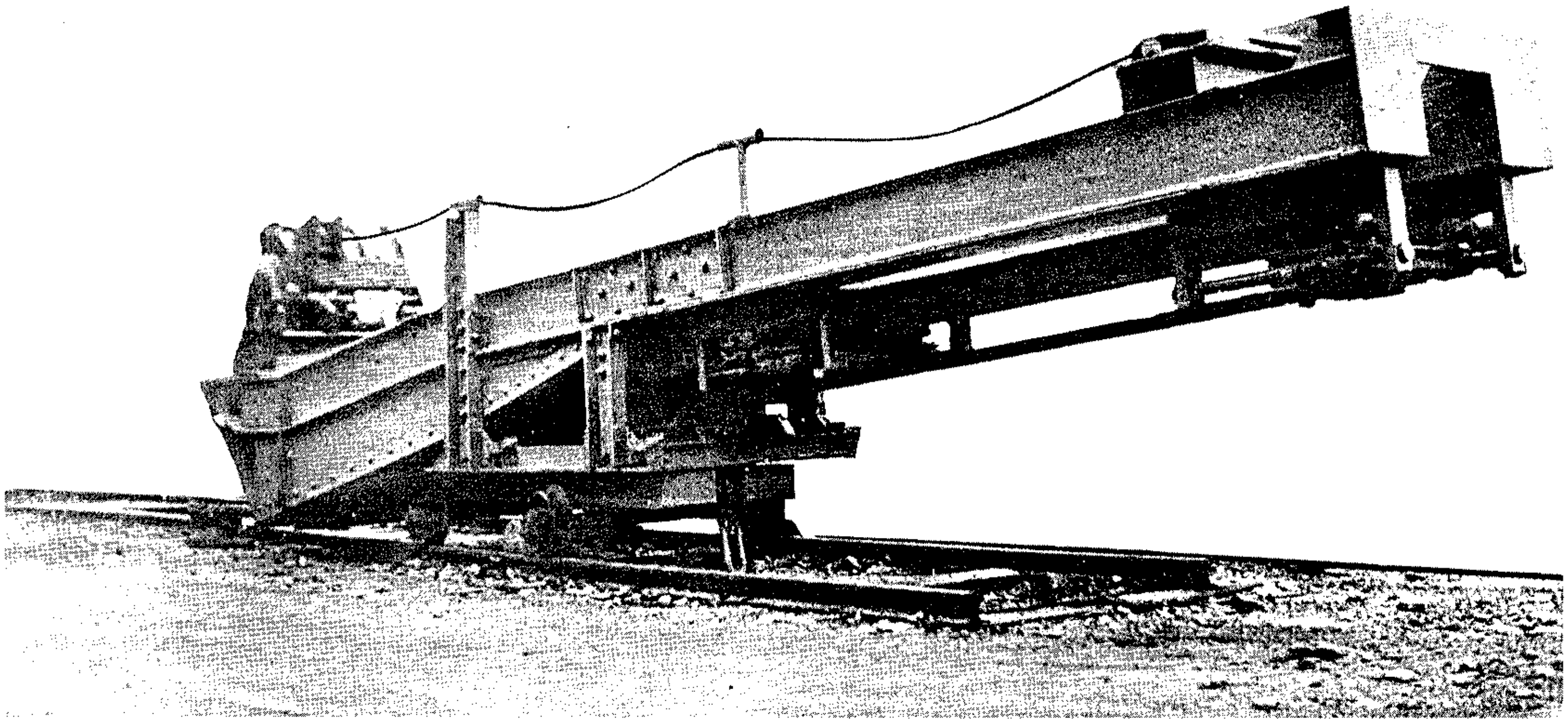

Figure 16. - Bureau of Mines scraper-shaker loading machine.

(5) infiltration of surface water into underground mine workings.[31, 32] Completion of the investigation of the acid-mine-water problem in the anthracite region revealed that industrial wastes in the streams flowing through the region neutralize the acid water from the mines.[33]

A study of barrier pillars, particularly in the area of the structural saddle in the Northern coal basin, was made to determine the size and condition of the pillars.[34] Various companies were contacted, and information was obtained regarding mine workings, barrier pillars, boreholes, overflow points, and other pertinent information concerning barrier pillars.

One phase of the mine-water problem as it pertains to the northern field of the anthracite region is the presence of the "buried valley" (filled ancient channels) of the Susquehanna River. This valley fill is water-bearing and irregular in trend and depth. The mining companies that have mined under and adjacent to the "buried valley" have drilled thousands of boreholes from the ground surface through the river wash down to bedrock to protect the workers underground and the mine workings. Data are being collected to establish definite limits to this "buried valley" and to study the nature of the material composing the water-bearing valley-fill deposit.

Use of Diesel Engines Underground

Diesel locomotives have been used successfully in European mines for 18 years, but the actual conditions under which they are used have not been publicized in the United States. Observations by Bureau representatives of European practice and a few instances of use of Diesel locomotives in the United States have shown that they can be safely used in both metal and coal mines. Published reports of these studies[35] state that, in European practice, the danger from sparks is eliminated by labyrinth spark arresters and from exhaust fumes by ventilation; adverse State regulations and some prejudices have prevented their adoption in the United States, but improved types will be made that should gain approval.[36, 37]

31/ Ash, S. H., Cassap, W. E., Westfield, J., Eaton, W. L., Romischer, W. M., Podgorski, E. J., and Johnson, L. H., Flood-Prevention Projects at Pennsylvania Anthracite Mines. Progress Report for 1946: Bureau of Mines Rept. of Investigations 4109, 1947, 64 pp.

32/ Ash, S. H., Cassap, W. E., Eaton, W. L., Hughes, K., Romischer, W. M., Westfield, J., Floot-Prevention Projects at Pennsylvania Anthracite Mines. Progress Report for fiscal year ended June 30, 1947: Bureau of Mines Rept. of Investigations 4288, 1948, 51 pp.

33/ Felegy, E. W., Johnson, L. H., and Westfield, J., Acid Mine Water in the Anthracite Region of Pennsylvania: Bureau of Mines Tech. Paper 710, 1948, 49 pp.

34/ Ash, S. H., and Eaton, W. L., Barrier Pillars in the Anthracite Region of Pennsylvania: Am. Inst. Min. and Met. Eng., Tech. Pub. 2289, Class F, Coal Technol., November 1947, 20 pp.

35/ East, J. H., Jr., Operating Diesel Locomotives Underground in European Mines: Bureau of Mines Inf. Circ. 7378, 1946, 13 pp.

36/ Harrington, D., and East, J. H., Jr., Diesel Equipment in Underground Mining: Bureau of Mines Inf. Circ. 7406, 1947, 87 pp.

37/ Harrington, D., and East, J. H., Jr., Diesel Power Can be Used Underground with Safety: Eng. and Min. Jour., vol. 148, No. 6, 1947, pp. 70-76.

Because of the interest in the application of Diesel engines in coal mines, their use for underground haulage in a clay mine was observed,38/ and tests were made to determine the composition of the exhaust gases produced by the engine under actual haulage conditions and to determine the effects of the operation on the quality of the mine atmosphere.

Studies were completed39/ on the removal of aldehydes from Diesel exhaust gas by scrubbing with an aqueous solution containing sodium sulfite (10 percent by weight) and hydroquinone (0.5 percent by weight). In this process, sodium sulfite is removed by the reaction: $Na_2SO_3 + HCHO + H_2O \longrightarrow NaOH + CH_2\ (NaSO_3)\ OH$. Hydroquinone is added to inhibit the oxidation of sodium sulfite by the residual oxygen in the Diesel exhaust gas.

The results of a full-scale test in which exhaust gas from an engine was passed through approximately 10 gallons of scrubbing solution at a rate of 3,000 cubic feet (at 29.92 inches of Hg and 60° F.) per hour are shown in figure 17. In this test, more than 90 percent of the aldehydes was removed for a period of 20.5 hours. The odor intensity of the raw and scrubbed gas was evaluated by averaging the sense impressions of twelve observers, and the results are presented in figure 18. Since the scrubbed gas was substantially free of aldehydes, the data indicate that the residual odor was caused by some other constituent. This residual odor ranged between faint and very faint and probably would be undetected when the exhaust is diluted with ambient air.

In the test described above, the cost of chemicals for removing aldehydes was 1.5 cents per M cu. ft. of dry exhaust gas (as 29.92 inches of Hg and 60° F.). If it is assumed that an engine produces an average of 5,000 cubic feet of dry exhaust gas per hour and operates continuously for 8 hours a day, the daily cost for chemicals would be about 60 cents.

A series of tests was made using a CFR Diesel engine to determine the effect of cetane number on the composition of the exhaust gas. The results of these tests showed that fuels having low cetane numbers produce slightly more carbon monoxide and aldehydes at the lower fuel : air ratios. However, at intermediate and high fuel : air ratios, cetane number has no significant effect on the production of these constituents. In view of the current difficulty in obtaining the higher-octane fuels, it may be necessary to increase ventilation slightly in underground applications of Diesel engines, particularly if the engine operates under light loads.

For the past several years, the Bureau of Mines has received many requests for information and recommendations on the use of Diesel-powered equipment in noncoal mines and other underground workings, where the material being mined is incombustible and the strata do not liberate combustible gases. To meet these requests, a schedule entitled "Requirements for Approval and Recommendations on the Use of Diesel-Powered Equipment in Noncoal Mines" was drafted.

38/ Berger, L. B., and Artz, R. T., Performance of a Diesel Mine Locomotive: Bureau of Mines Rept. of Investigations 4287, 1948, 15 pp.
39/ Davis, Rogers F., and Elliott, M. A., The Removal of Aldehydes from Diesel Exhaust Gas: Trans. Am. Soc. Mech. Eng., vol. 70, 1948, pp. 745-750.

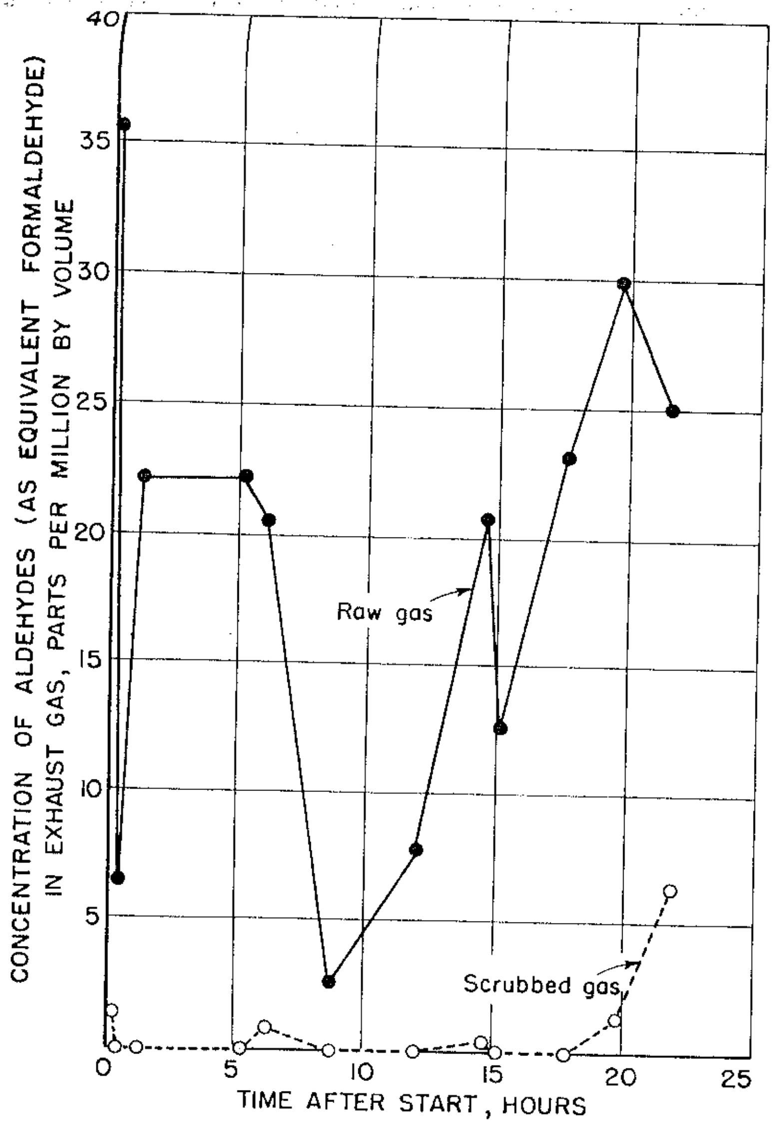

Figure 17. - Variation of aldehyde concentration in raw and scrubbed gas with time.

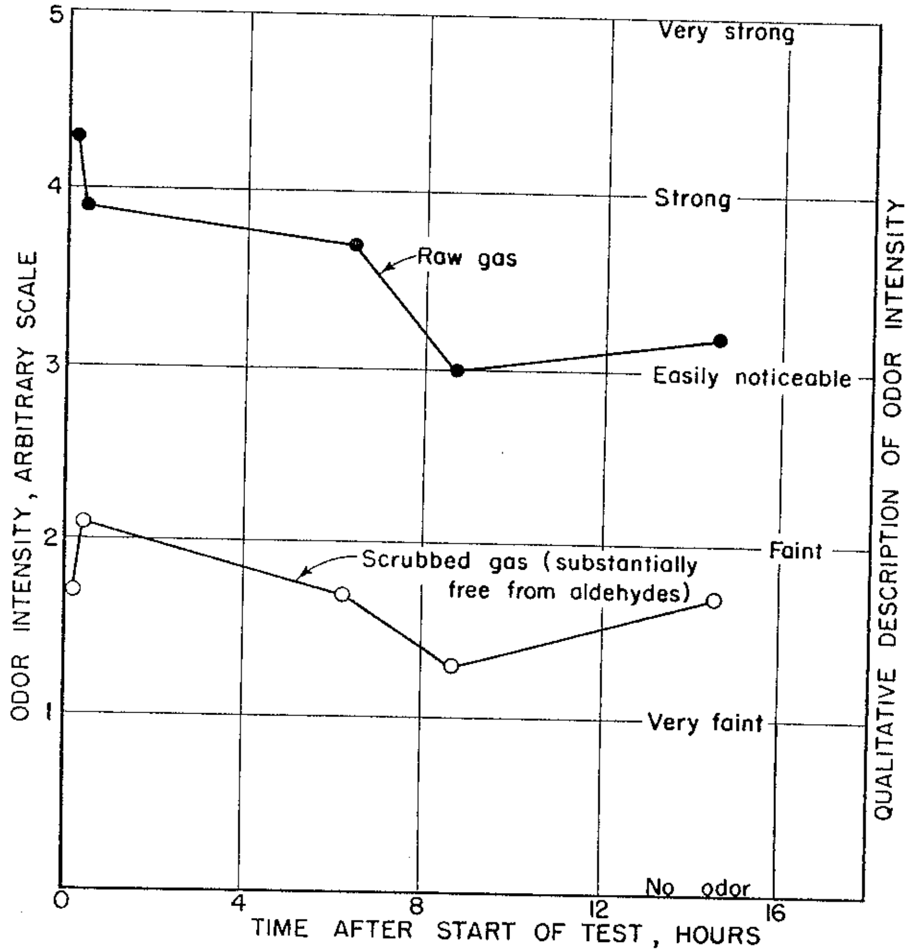

Figure 18. - Variation of odor intensity of raw and scrubbed gas with time.