



**TO STUDY & ANALYSIS THE DIFFERENT SOIL COLLECTED FROM RANCHI AREA
OF JHARKHAND- FIELD TO LAB BASED RESEARCH**

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ABSTRACT

A complex mixture of minerals, water, air, organic matter and micro organisms is known as soil, which forms the intermediate zone between the atmosphere and the lithosphere. Soil has a considerable effect on human health, whether those effects are positive or negative, direct or indirect. Soil is an important source of nutrients in our food supply and medicines such as antibiotics. Nutrient management is very important. Nutrient management is dependent on the collection and analysis of soil and plant samples for nutrient assessment. If Failure to understand soil testing uncertainty associated with sample collection and laboratory analysis can lead to misinterpretation and nutrient management failures. When collecting a soil one should consider agronomic production practices and their impact on soil spatial variability and analyses measurement uncertainty. The fertility or the expected growth potential of the soil which indicates nutrient deficiencies, potential toxicities from excessive fertility and inhibitions from the presence of non-essential trace minerals can determine by soil test .Soil sampling removes part of the soil from its natural environment. The extent of the activity change depends on the size of the soil sample and the subsequent sample treatment (sieving, drying, or cooling of field-moist samples). The test is used to mimic the function of roots to assimilate minerals. With decreased tillage and transition to strip till systems there is an increase in nutrient spatial and profile heterogeneity. With regard to laboratory analysis soil tests are subject to bias and laboratory measurement precision which varies by the test method utilized and the performance capability of the testing laboratory. Soil test based fertilization has now been recognized as an effective technology for achieving better use efficiency of fertilizers and also for sustaining the productivity of agricultural soils. Ranchi consists of tabular landmass. Fertility of the soils is dependent upon both the macro and micronutrient reserve of that soil. Vegetation of same crop repeatedly causes nutrient stress in plants and ultimately lowers the productivity. The fertility status of the soils mainly depends on the nature of vegetation, climate, topography, texture of soil and decomposition rate of organic matter.

KEYWORDS: Soil Sample, Growth, Health Impact, Media, Observation, Analysis.

INTRODUCTION

RANCHI

The capital of the Indian state of Jharkhand is **Ranchi**.^[1]
The Jharkhand movement was emerged from Ranchi.^[2]
They called for a separate state for the tribal regions of South Bihar, northern Orissa, western West Bengal and the eastern area of what is present-day Chhattisgarh. On

15 November 2000 the Jharkhand state was formed by carving out the Bihar divisions of Chota Nagpur and Santhal Parganas. Under PM Narendra Modi's flagship Smart Cities Mission, Ranchi has been selected as one of the hundred Indian cities to be developed as a smart city.^[3]



Figure 1: Showing the Political Map of Ranchi- Jharkhand.

Ranchi lies at 23°22'N 85°20'E near to the Tropic of Cancer. Its municipal area is 652.02 km² (251.75 sq mi) (Figure 1), and its average elevation is 651 m above sea level. Ranchi is surrounded by lush agriculturally fertile land. Ranchi is located in the southern part of the Chota Nagpur plateau, which is the eastern section of the Deccan plateau. Ranchi has a hilly topography and its dense tropical forests a combination that produces a relatively moderate climate compared to the rest of the state. However, due to the uncontrolled deforestation,

and development of the city, the average temperature has increased.^[4] Ranchi is well known for its location and unusually pleasant climate because it is surrounded by forests. In summer and winter temperatures range from 20 °C to 42 degrees and 0 °C to 25 degrees respectively (Table 1). December and January are the coolest months, with temperatures dipping to the freezing point in some areas (Kanke). The annual rainfall is about 1430 mm (56.34 inches). From June to September the rainfall is about 1,100 mm.^[5]

Table 1: Showing the Climatic Conditions of Ranchi.

Climate Data for Ranchi				
Month	Average high °C (°F)	Daily mean °C (°F)	Average low °C (°F)	Average precipitation m m (inches)
January	23.6 (74.5)	16.7 (62.1)	9.8 (49.6)	16.7 (0.66)
February	26.3 (79.3)	19.5 (67.1)	12.6 (54.7)	21.2 (0.83)
March	31.5 (88.7)	24.2 (75.6)	21.2 (70.2)	25.0 (0.98)
April	35.6 (96.1)	28.4 (83.1)	21.2 (70.2)	21.8 (0.86)
May	36.8 (98.2)	30.1 (86.2)	23.3 (73.9)	61.7 (2.43)
June	33.4 (92.1)	28.5 (83.3)	23.5 (74.3)	249.4 (9.82)
July	29.8 (85.6)	26.3 (79.3)	22.7 (72.9)	336.6 (13.25)
August	29.2 (84.6)	25.8 (78.4)	22.4 (72.3)	319.1 (12.56)
September	29.4 (84.9)	25.6 (78.1)	21.8 (71.2)	247.3 (9.74)
October	28.9 (84.0)	23.4 (74.1)	18.6 (65.5)	76.6 (3.02)
November	26.5 (79.7)	20.1 (68.2)	13.6 (56.5)	10.8 (0.43)
December	24.0 (75.2)	17.0 (62.6)	9.9 (49.8)	11.6 (0.46)
Year	29.3 (84.7)	23.8 (74.8)	18.0 (64.4)	1,397.7 (55.03)

SOIL

Many words that we use every day have several meanings and may be used in various ways. The word soil is no exception. As a transitive verb it means, "to make dirty" as in the case of solid dishes or clothing. The word soil is derived through from the Latin word solum, which means floor or ground. Many people, when they think of the word soil, have in mind that material which nourishes and supports growing plants. This meaning is even more general, since it includes not only soil in the common sense, but also rocks, water, snow, and even air—all of which are capable of supporting plant life. The farmer, of course, has a more practical conception of soil; to him it is the medium in which crops grow. The civil engineer, on the other hand, looks upon soil as that material which supports foundations, roads, or airport runways. A complex mixture of minerals, water, air, organic matter and micro organisms is known as soil^[6-8] which forms the intermediate zone between the atmosphere and the lithosphere. It's a part of biosphere which forms the interface between hydrosphere and the lithosphere. Soil is a product of various factors like the influence of climate, relief, organisms, and the soil's parent materials interacting over time.^[9] It continually undergoes development by numerous physical, chemical and biological processes including weathering associated with soil erosion. Due to its complexity and strong internal connectedness, soil ecologists considered soil as an ecosystem.^[10] Soil quality can be checked by four parameters. Those are visual, physical, chemical and biological properties. The soil is a complex organization

made up of some six constituents i.e. inorganic matter, organic matter, soil organisms, soil moisture, soil solution and soil air. Roughly 50-60% mineral matter, 25-35% water, 15-25% air and little amount of organic matter are present in soil.^[11] Due to daily activity of man soil is getting polluted day by day. The contamination of fields by metallic elements and their aerial deposition is likely to result in a corresponding contamination of harvested crops and the impact on food consumers.^[12-14] The waste generate by human activities, and the way in which this is handled, stored, collected and disposed poses risk of environmental pollution and public health.^[15] Because of the heterogeneity and complexity of wastes the dumpsites contain a variety of contaminants which can pollute the soil of the area.^[16] At these sites The Physico-chemical properties of the degraded soils are one of the important factor vegetation developments.

Proportions of the components vary from time to time and from place to place. The volume of water and air bear a direct reciprocal relationship with each other. Entrance of water into the soil excludes air. As water is removed, by drainage, evaporation, or plant growth, pore space that was occupied by water becomes filled with air once more. Considerably less organic matter than surface soils generally characterizes sub soils. An organic soil, like a muck or peat, has a greater volume occupied by organic matter than by mineral matter. Soils used in greenhouses are manufactured in the sense that topsoil, sand, and organic matter are mixed together to provide a

desirable proportion of the four components. Soil as ordinarily found in the field is not suited for golf greens. When the soil surface is wet, traffic causes soil compaction, and the maintenance of favorable air and water relationships is difficult. In the construction of a golf course, the sites where the greens will be located are excavated and refilled with a base layer high in sand and gravel to provide good drainage. This is overlain by a layer, which is commonly 12 inches thick and composed of a mixture of sand, topsoil, and organic matter (peat).

Soil fertility is defined as the quality that enables a soil to provide the proper compounds, in the proper amounts, and in the proper balance, for the growth of specified plants when other factors are favorable. Soil productivity, on the other hand, is defined as "the capability of a soil for producing a specified plant or sequence of plants under a specified system of management". For a soil to be productive it must of necessity be fertile. It does not follow, however, that a fertile soil is productive. For instance, many fertile soils exist in arid regions, but under systems of management, which do not include irrigation they cannot be productive for corn or rice. A most important fact to keep in mind is that the productivity of a soil is measured in terms of a given kind of crop or sequence of crops. A soil may be productive for blueberries, which require very acid conditions, but be unproductive for alfalfa, which requires a nearly neutral soil with an abundance of available calcium. A soil may currently be unproductive for corn because of its low fertility but owing to the much lower fertility demands of some tree species, may have been very productive for the original stand of pines that occupied the virgin soil. Different physical properties of soil depend upon soil texture, soil structure, soil density and weight, pore space of soil, soil colour etc. The relative size of the soil particles is expressed by the term texture, which refers to the coarseness of the soil. More specifically, texture is the relative proportions of the different size groups or separates. The rate and extent of many important physical and chemical reactions in soils are governed by texture because it determines the amount of surface on which the reactions can occur. The determination of the amount of the various separates present in the soil is called a mechanical analysis. The color of soil serves both farmer and soil scientist, provided that they understand the causes of the various colors and are able to interpret

them in terms of soil properties. Organic-matter content, drainage condition, and aeration are soil properties related to color, which are of interest to farmers. The investigator uses color as an aid in soil classification and draws from the color of the different horizons information about conditions pertaining to and forces active during soil formation.

Color is the sensation produced when light from an object enters the human eye. Thus the color of a soil is the result of light reflected from the soil. The color of light can be accurately described by measuring its three principal properties, hue, value, and can be shown by use of a solid, for example a cube, in which hue, value, and chroma. Hue refers to the dominant wavelength or color of the light. Value, sometimes called brilliance, refers to the total quantity of light. It increases from dark to light color. Chroma is the relative purity of the dominant wavelength of light.

DIFFERENT TYPES OF SOIL OF RANCHI

Red soil, black soil, sandy soil, micaceous soil, laterite soil is found in Jharkhand. The soil has been formed from disintegration of stones and rocks. Three soil orders namely Entisols, Inceptisols and Alfisols were observed in different districts of Jharkhand. The soil of Jharkhand may be broadly be classified into following five groups:-

1. Red Soil
2. Sandy Soil
3. Black Soil
4. Laterite Soil
5. Red micaceous Soil

Red Soil

These soils are made by the decomposition of crystalline metamorphic rock such as granite, gneiss, etc. The colour of the soil is red at some places and at many places it is just like chocolate which is dark in colour. This type of soil is found in most areas of Jharkhand except in narrow trough basin of Damodar and in Rajmahal areas. (Figure 2).

Sandy Soil

This type of soil is found in east Hazaribagh and Dhanbad (Figure 3). These two areas compose the trough basin of Damodar, which is famous for sandy soil. Such soil is formed by the gradual decomposition of sandy loam and sandy soil.



Figure 2: Showing the Red Soil of Rajmahal Area, Figure 3 Showing the Sandy Soil of Dhanbad Area, Figure 4 Showing the Black Soil of Rajmahal Area, Figure 5 Showing the Laterite Soil of Western Ranchi, Fig 6 Showing the Red micaceous soil at Koderma Area.

Black Soil

The soil is found in the Rajmahal areas. The soil of Rajmahal contains basalt (Figure 4). The main ingredients are Kaolin, Potash and Iron-Oxide. This soil has higher proportion of clay, which has a very high water retaining capacity. The areas with higher elevation has thin layer of black soil with light colour but in areas with lower heights, the soil has thick layer and dark colour.

Laterite Soil

The laterite soil is found in the highlands of Rajmahal, western Ranchi plateau and Pat region of south Palamu, and Dhalbhum area of Singbhum (Figure 5). The main components of this soil are aluminum, iron oxide and manganese oxide. The main defect of the soil is acid reaction.

5. Red Micacious soil

This soil is mostly found in mica areas of Jharkhand such as Koderma, Mandu, Jhumri- Tilaiya, etc (Figure 6). This soil becomes lightpink in areas of higher elevation. Studies have shown that soil acidity together with low potassium and sulphur content, moderate nitrogen together with the deficient in zinc and born certainly indicate in general the low fertility of the soil in Jharkhand.

MICROORGANISMS FOUND IN SOIL

Soil microbiology is the study of microorganisms in soil, their functions, and how they affect soil properties. It is believed that between two and four billion years ago, the first ancient bacteria and microorganisms came about on Earth's oceans. These bacteria could fix nitrogen, in time multiplied, and as a result released oxygen into the atmosphere.^[17,18] This led to more advanced microorganisms^[19,20] which are important because they affect soil structure and fertility. Each of these groups has characteristics that define them and their functions in soil.^[21,22]

Up to 10 billion bacterial cells inhabit each gram of soil in and around plant roots, a region known as the rhizosphere. In 2011, a team detected more than 33,000 bacterial and archaeal species on sugar beet roots.^[23] The composition of the rhizobiome can change rapidly in response to changes in the surrounding environment.

- 1. Bacteria:-** Bacteria and Archaea are the smallest organisms in soil apart from viruses. Bacteria and Archaea are prokaryotic. All of the other microorganisms are eukaryotic, which means they have a more advanced cell structure with internal organelles^[21,22] and the ability to reproduce sexually. A prokaryote has a very simple cell structure with no internal organelles. Bacteria and Archaea are the most abundant microorganisms in the soil, and serve many important purposes, including nitrogen fixation.^[24]
- 2. Actinomycetes:-** Actinomycetes are soil microorganisms. They are a type of bacteria, but

they share some characteristics with fungi that are most likely a result of convergent evolution due to a common habitat and lifestyle.^[25]

- 3. Fungi:-** Fungi are abundant in soil, but bacteria are more abundant. As the food of larger organisms, pathogens fungi are important. They are also beneficial for symbiotic relationships with plants or other organisms and soil health. Fungi can be classified into different species based primarily on the size, shape and colour of their reproductive spores, which are used to reproduce. Most of the environmental factors that influence the growth and distribution of fungi. As most fungi consume organic matter for nutrition, the quality as well as quantity of organic matter in the soil has a direct correlation with the growth of fungi. Fungi found in acidic, dry, arid soils areas as they grow in acidic environments and are aerobic.
- 4. Algae:-** Algae can make their own nutrients through photosynthesis. Photosynthesis converts light energy to chemical energy that can be stored as nutrients. Light is essential for the growth of algae. That's why algae distributed evenly wherever sunlight and moderate moisture is available. Algae do not have to be directly exposed to the Sun, but can live below the soil surface given uniform temperature and moisture conditions. Algae are also capable of performing nitrogen fixation.^[21,22]
- 5. Protozoa:-** Protozoa are eukaryotic organisms that were some of the first microorganisms to reproduce sexually, a significant evolutionary step from duplication of spores, like those that many other soil microorganisms depend on. Protozoa can be split up into three categories: flagellates, amoebae and ciliates.^[25]

ROLE OF MICROORGANISMS IN SOIL

For decomposing organic matter, cycling nutrients and fertilising the soil Soil microorganisms play an essential role. Soil microbes are of prime importance in this process. Soil microbes are also important for the development of healthy soil structure. Although soil organisms comprise <1% of the total mass of a soil, they have a vital role in supporting all plants and thus animals. Some of their vital functions are described below.

- 1. Soil microbes recycle nutrients:-** Soil microbes play a crucial role in returning nutrients to their mineral forms, which plants can take up again. This process is known as mineralization.
- 2. Soil microbes create humus:-** When the soil microbes have broken down all they can, what's left is called humus, a dark brown jelly-like substance that can remain unchanged in the soil for potentially millennia. Humus helps the soil retain moisture, and encourages the formation of soil structure.
- 3. Soil microbes fix nitrogen:-** Agriculture depends heavily on the ability of certain microbes (mainly bacteria) to convert atmospheric nitrogen (N₂ gas)

to ammonia (NH₃). Some live freely in the soil, while others live in association with plant roots – the classic example is *Rhizobium* bacteria in the roots of legumes. The process of conversion is known as nitrogen fixation.

4. **Soil organisms promote plant growth:**-Some soil microbes produce a variety of substances that promote plant growth, including auxins, gibberellins and antibiotics.
5. **Soil microbes control pests and diseases:**-The best known example of the use of soil microbes in pest control is the commercial production of the soil bacterium *Bacillus thuringiensis* (*Bt*) to control caterpillar pests of crops. Some strains of *Bt* are used to control beetles and flies as well. Several strains of the fungal genus *Trichoderma* have been developed as biocontrol agents against fungal diseases of plants, mainly root diseases. Various other genera of fungi are used for the control of insect pests.

IMPACT ON HUMAN HEALTH

Soil has a considerable effect on human health, whether those effects are positive or negative, direct or indirect. Soil is an important source of nutrients in our food supply and medicines such as antibiotics. However, nutrient imbalances and the presence of human pathogens in the soil biological community can cause negative effects on health. There are also many locations where various elements or chemical compounds are found in soil at toxic levels, because of either natural conditions or anthropogenic activities. The soil of urban environments has received increased attention in the last few years, and they too pose a number of human health questions and challenges. Concepts such as soil security may provide a framework within which issues on soil and human health can be investigated using interdisciplinary and transdisciplinary approaches. It will take the contributions of experts in several different scientific, medical and social science fields to address fully soil and human health issues. Although much progress was made in understanding links between soil and human health over the last century, there is still much that we do not know about the complex interactions between them. Therefore, there is still a considerable need for research in this important area.



Fig 7: Showing the Germination of Seed in the Soil.

The importance of soil in shaping ecosystems and human civilization is hard to exaggerate, but since soil is hard to see and study, it often isn't considered at all. Numerous studies have shown that the availability of nutrients

originating from soil limit the productivity of terrestrial ecosystems, and often limit the local availability of food. Past civilizations have risen when the fertility of the local soils allowed the production of food in excess of need, allowing human efforts to focus on government, industry, artistic and military pursuits. Recent human experience has largely forgotten that essential tie to the land, though it is just as important now as it was thousands years ago. Currently, many of the predicted systems are available, and could potentially be utilized to produce a substantial amount of food and raw materials if necessary, but at considerably higher cost than soil-based agriculture. Soilless agriculture produces a very small amount of our current food supply, usually only specialty and very high priced seasonal crops such as tomatoes, lettuce and cucumbers. More common perhaps, is the production of "artificial" or "enhanced" soils for a variety of purposes. Soils cannot only be amended with chemical nutrients to increase their fertility, but also can they be amended to change their physical, chemical and biological properties. For such an important resource on which humans rely so much for their food supply and other important renewable resources and environmental services, it appears that society has lost much of its previous direct and practical knowledge of soil functioning of the ecosystem.

MATERIALS AND METHODS

Collection of Soil Samples

Soil samples were collected from four different areas namely Harmu, Hatiya, Nivaranpur and Dhurwa of Ranchi, Jharkhand (Figure 8). During my experiment following instruments and chemicals were used namely: sterilized glassware, Petri dish, conical flask, autoclave, incubator, microscope, inoculation loop, pipette, ethanol, cotton, slides, distilled water, nutrient agar, saffranin (used as bacterial stain). The texture of the soils remained sandy and clay. The soil were then carefully taken out, the soil core inside was pushed out, labeled and packed in a polythene bags (Figure 9).



Figure 8: Showing the collection of soil samples,



Figure 9: Showing the collected Soil samples.

Later, these collected soil samples were transferred to

laboratory for further processing. The soil is an extremely complex matrix to analyses, particularly on contaminated sites. The actual soil matrix can vary from sand (silica) to limestone (calcium carbonate) to clay (complexes minerals) or a mixture of many. In addition to this, the range of contaminants varies from fairly innocuous construction materials to toxic gasworks waste to highly toxic pharmaceutical waste/ mercury/ explosives, etc.

Methods of Soil Samples

This is an absolutely critical step and tends to be overlooked in review of methods but if the preparation is

not carefully done then no amount of sophisticated instrumentation will improve the result. At the laboratory, each sample is assigned an identification number, transferred to a paper bag, and then placed in a metal tray (Figure 10). Nutrient agar media was prepared in the laboratory; collected sample was taken and serially diluted. Pouring was done of media and allowed to solidify (Figure 11). Serially diluted samples were used for spreading Petri plates was left for growth in incubator (Figure 12). An incubated colony was selected by slide preparation in which with the help of saffranin slide was prepared (Figure 13). At last, the slides were observed under the microscope.



Figure 10 & 11: Showing of different soil samples in Petriplates & Pouring of soil samples.



Figure 12 & 13: Showing the Petriplates left for growth in the incubator for further observation & Slide Preparation.

RESULTS AND OBSERVATION

The results of the soil samples were taken from the experiment performed in the laboratory. Table- 2 shows the results of the soil samples.

Table-: Showing the soil samples and their Colony Count with Growth Rate.

Name Of The Soil Sample	Colony Count	Growth Rate
Dhurwa	10	Yes
Harmu	6	Yes
Hatia	14	Yes
Nivaranpur	7	Yes

The data on growth of experimental sample of soil have been presented in the above table. The growth rates of the microorganism have been clubbed for two days interval depending upon range of variation. After analysis of the table it is clearly specified that growth

rate of microorganism in Hatiya is high. The result indicates that Hatiya may be suitable for crops and vegetables. However the following soil samples growth rate and colony which have been observed in Figure- 14, 15,16,17,18.



Figure 14 & 15: Showing the Growth rate of Microorganism present in Hatia Sample & in Dhurwa Sample.

By observing in the compound microscope morphologically the soil may be *Bacillus* and *Rhizobium* type of species. *Bacillus* species are rod-shaped, endospore-forming aerobic or facultative anaerobic, Gram-positive bacteria; in some species cultures may turn Gram-negative with age.

Many species of the genus exhibit a wide range of physiologic abilities that allow them to live in every natural environment whereas the *Rhizobium* is a genus of gram-negative, motile bacteria whose members are the most notable for their ability to establish a symbiotic relationship with leguminous plants, such as peas, soybean, and alfalfa.



Figure 16 & 17: Showing the Growth rate of M/O in Nivaranpur Sample, in Harmu Sample, Figure 18 Showing the no Growth rate of M/O as in Control Sample.

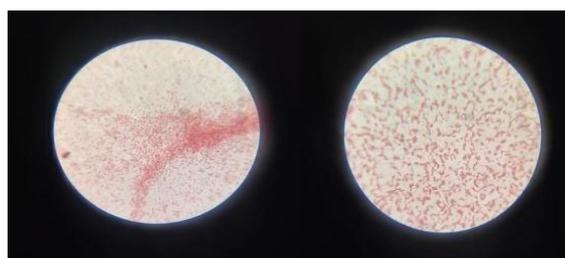


Figure 19 & 20: Showing the Microorganisms found in Dhurwa soil sample & in Harmu soil sample.

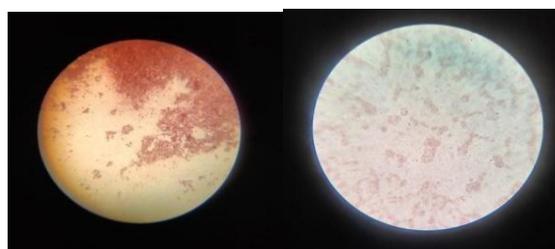


Figure 21 & 22: Showing the Microorganism found in Nivaranpur soil sample & in Hatia soil sample.

The observation shows the superiority and suitability of soil sample collected from four different areas of Ranchi, Jharkhand over the other soil sample for growth and development of microbes (Figure-19, 20, 21, 22).

CONCLUSION

The analysis soil has completed in six processes, which are soil sampling technique, determination of texture of soil, determination of water content, determination of

organic matter, determination of air content and soil pH. In the determination of texture of soil, it can be concluded that soil sample from housing area which is Harmu has the highest percentage of stone component whereas soil samples from the other soil sample areas. From all the soil samples I concluded that growths of microorganisms were found in all the four soil samples which were collected. Thus, the conclusion based on my experiment concluded me that soil testing is key element

in assessing the fertility status of soil and hence can be effectively used for assessing plant nutrient requirement. Soils differ in their ability to supply nutrients to plant. Soil is the vital eco-compartment acting as a sink for natural and anthropogenic pollutants. Through soil test we can nutrient deficiencies, potential toxicities from excessive fertility and inhibitions from the presence of non-essential trace minerals which indicates the fertility or the expected growth potential of the soil. Soil sampling and testing can show us the plant available nutrients and other soil chemical factors important for production.

Soil test act as a medium for the plant growth and also as a nutrient supply to the plants. Further long study required to give the clear cut suggestion and conclusion.

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