pointer of this gauge was set by the makers to read the absolute pressures directly on the dial. The gauge calibrations were checked with a dead-weight tester and were found to be correct to ±1 lb. per sq. in. up to 1,500 lb. per sq. in.

TABLE I

Dimensions of the diaphragms and their maximum service pressures

Diaphragm No.	I	II	III	IV
Thickness over flat portion (t in.)	0·0945	0·0735	0·0640	0·0420
Diameter of diaphragm (D in.)	1·250	1·226	1·250	1·25
Fillet radius (R in.)	0·04	0·05	0·06	0·15
Radius of flat portion (D/2 − R)	0·585	0·563	0·565	0·475
Width of rim (A in.)	0·21	0·22	0·21	0·21
Thickness of rim (B in.)	0·20	0·19	0·18	0·25
Maximum Service Pressure (lb./sq. in.)	1300	900	700	450

The results obtained are shown graphically in Fig. 2. In each case, the plot of strain *vs.* pressure gave a straight line. Within the limits of maximum service pressures given in Table I, the diaphragms were perfectly elastic and responded to rising and falling pressures without lag and without hysteresis or creep. The pressure *vs.* strain calibrations were remarkably stable and the slope of strain to pressure was maintained even after the diaphragms had been dismantled and reassembled.

Table II shows a typical set of data obtained in four calibrations with Diaphragm III, on which a strain-increase of 1μ in./in. corresponds nearly to an increase 1 lb./sq. in. in the pressure. It is evident from the table that the largest average deviation from the mean values is 1·25; *i.e.*, 1/6 per cent. of the full range value of 706 μ in./in. Even towards the lower end of the scale (*e.g.*, 100 lb./sq. in.) the average error is less than ½ per cent. of the mean value for that pressure, but less than 1/11 per cent. of the full-scale value.

TABLE II

Results obtained with diaphragm III in four runs

Pressure lb./sq. in.	Strain in μ in./in.					Average deviation from the mean	Percentage of Av. Devn. / Av. strain
	1	2	3	4	Mean		
13·4	0	0	0	0	0	..	..
100	86	86	85	86	85·7	0·4	0·46
200	189	189	187·5	187·5	188·3	0·7	0·37
300	291	290	290	290	290·3	0·4	0·14
400	394	395	394	395	394·5	0·5	0·13
500	499	499	496·5	496·5	497·8	1·25	0·25
600	601·5	603	600·5	601·5	601·6	0·68	0·11
700	706	706	706	706	706	0·00	0·00

Apart from the accuracy, the method suggested above carries with it, all the advantages common to electrical methods, such as adaptability for remote control, wide choice of accessory apparatus, interchangeability of components, etc.

The variation of strain with pressure is being further examined.

Our sincere thanks are due to Prof. B. C. Carter, Head of the Department of Internal Combustion Engineering, for many helpful suggestions.

METALLOGENETIC EPOCHS IN INDIA

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CERTAIN relations between the formation of ore-deposits and other geological processes are now generally accepted, namely, that many metal deposits are closely associated with igneous activity, that igneous activity occurs in belts of strong folding and faulting in orogenic belts, and that ore depositions have been repeated through geological time resulting in rather definite periods in which metalliferous deposits have formed. These periods of metal deposition are known as metallogenetic epochs.

In Europe, four systems of folding or orogenic periods have been recognized, namely, Huronian (or Charnian), Caledonian, Hercynian and Alpine. Most of the metal deposits there result from igneous activity related to these periods of folding and faulting.

The Huronian movement is mainly confined to the great shield of Fenno-Scandia, to Sweden, Norway and Finland. The deposits carry mainly iron and copper. The rich magnetite deposit at Kirunavaara associated with a syenite porphyry is believed to be of this age.

The lead and zinc lodes of Leadhills and Wanlockhead in Scotland are attributed to the Caledonian folding as also the ores of copper, nickel, titanium and chromium of northern Norway connected with gabbros in the Cambrian-Silurian complex.

The Hercynian movement came between the Carboniferous and the Trias and resulted in great mountain chains extending east and west across Europe. In England, this is known as the Pennine-Armorican movement; and the formerly copper but now tin, and the lead and zinc lodes of Devon and Cornwall are genetically connected with the west-of-England granites. Although their direct association with any intrusive body is not obvious, the lead and zinc lodes in the Carboniferous limestone of the Pennine range at intervals from Derbyshire to Northumberland are connected with the Pennine folding.

In the continent, the Linares field, once the most prolific lead mines in the world, and the equally famous Rio-Tinto and Tharsis mines in Spain, the classical lead and zinc veins of Clausthal in the Hartz mountain, the Erzegebirge field, the tin fields at Zinnwald in Germany are all connected with granites and with the Hercynian movement. The Altaid mineral deposits of the Urals and the poly-metallio lodes of Balkash in Eastern Russia, and along the Russo-Afghan border all belong to this period.

With the ridging up of the Alps, southern Europe became the scene of great activity in connection with igneous outburst. The lead and zinc deposits of Raibl in Italy, Bleiberg in Austria and Mesieza in Yugoslavia are connected with the great Alpine intrusions of granitic rocks. The Eocene intrusions of peridotite, gabbro, etc., gave rise to the magmatic chromite deposits in Greece and Asia Minor. The metal mercury is especially associated with this movement; the Spanish Almaden mines and the Idria mine in Italy are of this period.

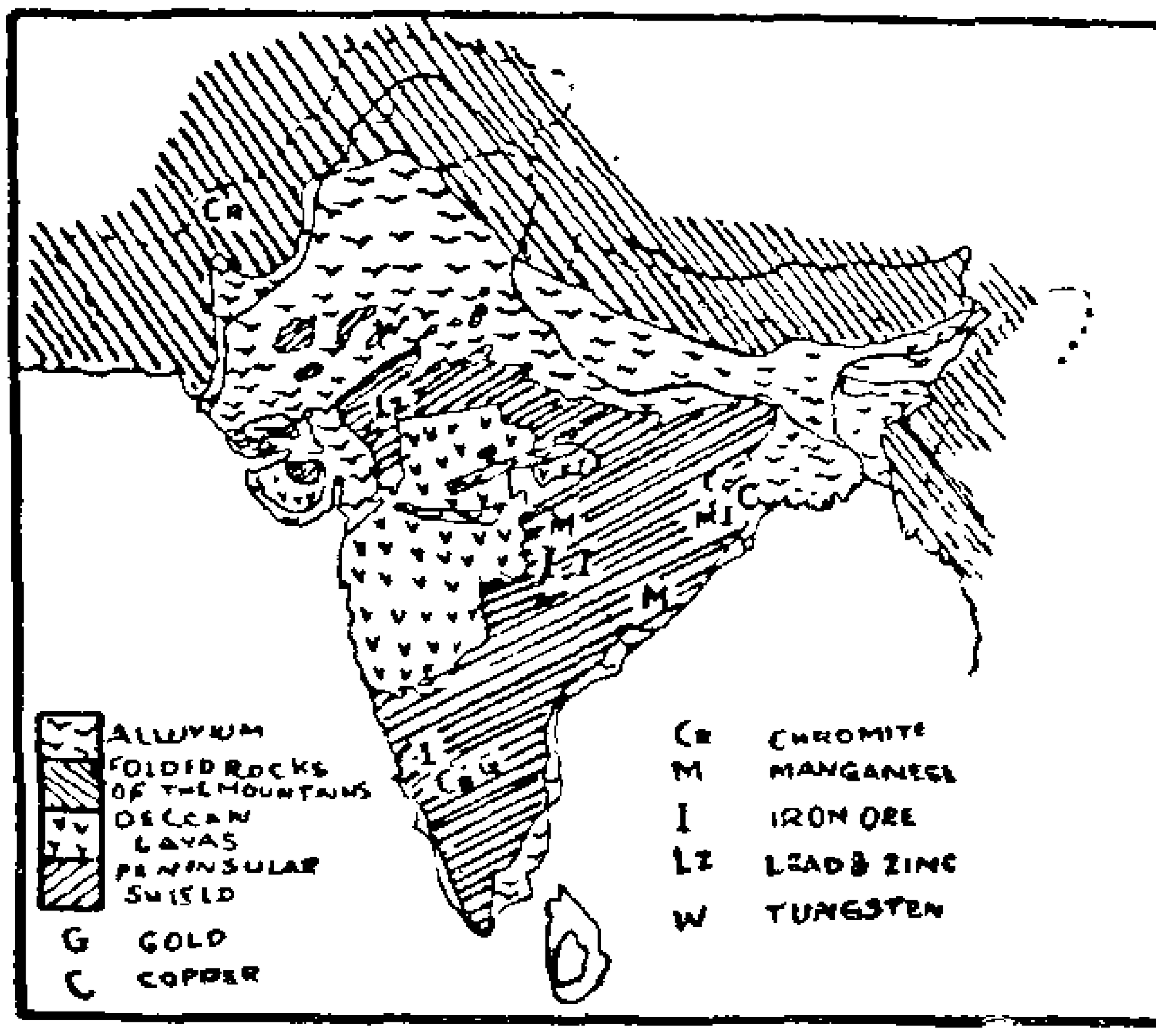
In the United States of America, taking the Cordilleran region alone, which is one of the great mineral store-houses of the world, we find that here three distinct metallogenetic epochs are recognized, *viz.*, pre-Cambrian, post-Jurassic and late Cretaceous—Tertiary the last two of which are clearly related to periods of mountain-building. The Sierra Nevada and the Coast Range are post-Jurassic in age and the mineral deposits that occur here are genetically related to the Sierra Nevada and the Coast Range granodiorite batholiths. The metals worked are gold, copper, lead and zinc.

The Rocky mountains were ridged up from late Cretaceous to Tertiary, and the mineral deposits around the Columbia and Colorado plateaux are connected with igneous activity that took place about this time. The metals mined are silver, gold, lead and zinc (not conspicuous), tellurium, antimony and quicksilver.

In Asia, pre-Cambrian deposits are represented by gold-bearing veins in the great shield extending on both sides of Lake Baikal and in Korea, and in the Indian Peninsular Shield. Deposits of Hercynian or late Palæozoic age are found in many ranges in Central Asia, such as the Urals, the Altai and the Trans-Baikalian mountains. Gold, lead, silver and other metals are found here in well-defined veins. To the same age are referred the tin and wolfram deposits of Malaya, Burma, Siam and China.

In southern China at least five orogenic periods have been recognised, *viz.*, Caledonian, Hercynian, Anyuanian (late Triassic), Yenshanian (phase A in late Jurassic, phase B between Cretaceous and Eocene) and Nanlingian (middle Tertiary). Of the three metallogenetic periods in China, namely, (1) Pre-Cambrian, (2) Hercynian and (3) Tertiary, the first is connected with deposits of gold, tungsten and molybdenum the next with tin, zinc and antimony, and the third with mercury: all genetically related to granitic intrusions.

In India, the two generally accepted orogenic movements are the pre-Cambrian, which ridged up the Aravalli mountains and the Himalayan in Tertiary time. Recently, however, Prof. Pichamuthu has been able to decipher two more orogenic periods in the Dharwars of South India.



From a study of the metal deposits of India and Burma five metallogenetic epochs can be pretty well recognized, namely, pre-Cambrian, Malani (pre-Vindhyan), Caledonian, Hercynian and Cretaceous.

As producers of economic deposits, however, the pre-Cambrian is the most important epoch in India, while in Burma, both the Caledonian and the Hercynian are of great importance.

Covering nearly one-third of India's sixteen lacs square miles, the Peninsular Shield contains nearly all her metal deposits including the most important ones, *viz.*, gold, copper, chromite, iron and manganese (the last two being sedimentary).

In the Dharwars of South India occur the gold-bearing quartz-veins related to the granitic constituents of the Champanir gneiss. Belonging to the iron-ore series are the Singhbhum copper deposits related to a Soda granite. The Khetri copper deposit is in Aravalli slates.

The Mysore, Madras, Keonjhar and Singhbhum chromite deposits are genetically connected with the ultra-basic rocks in which they occur.

It is, however, too early to say to which of the two Dharwarian orogenic movements these several metal deposits owe their origin.

The wolfram deposit of Degana in Jodhpur State and the Jawar lead and zinc deposit in Udaipur State are intimately connected with the Jalore and Siwana granites of Malani age.

Related to the Tawnpeng granite the Bawdwin lead, zinc and silver deposits have been assigned a Cambrian age (not with great certainty), and possibly owe their origin to some movement corresponding to the Caledonian in Europe. The Mawson lead deposits also belong to this period.

To the Hercynian we owe the tin and wolfram deposits of Burma, the zinc deposit of Riasi in Kashmir, and the orpiment deposit of Chitral.

Closely connected with the late Cretaceous movement, well recognized in Burma, are the chromite deposits of the Arakan range and of Pishin-Zhob in Baluchistan.

The *following table gives an idea of the* repetition of metal deposition through geological time.

Period	Europe	North America	Asia	India and Burma
Pre-Cambrian ..	Iron, Copper	Gold, copper, nickel, silver	Gold	Gold, copper, chromium
Malani ..	..		..	Tungsten, lead, zinc
Caledonian ..	Lead, zinc, copper, nickel, titanium, chromium	Gold	..	Lead, zinc, silver, nickel
Hercynian ..	Copper, tin, lead, zinc	..	Gold, lead, silver, zinc, antimony	Zinc, tin, tungsten, arsenic
Cretaceous ..	..	..	Gold, copper, lead, zinc, silver	Chromium
Tertiary ..	Lead, zinc, chromium mercury	Gold, silver, copper lead, zinc, arsenic, antimony, mercury	Gold, copper, antimony, mercury	..

OCCASIONAL DISTANT WEATHER INFORMATION AND FORECASTING

S. L. MALURKAR

(*Poona* 5)

A WEATHER forecaster depends entirely on the amount of meteorological observation that he has at the time of issuing forecasts. It often happens that at certain places, the amount of weather information is limited due to communication difficulties. During the period of war, much of the needed weather information is absent. The forecaster has to strain to deduce more results with the little information he has. The method of deducing the results here, follow from the book *Forecasting Weather In and Near India.*[1]

If a broadcast or news item gives an account of extensive damage due to weather in the tropics, away from the equator, it is most likely that a cyclonic storm or typhoon would have been responsible for the damage. If, in the equatorial regions, heavy rain is reported in the absence of cyclonic storms, it shows the passage of 'pulses' of maritime air which may later in their travel cross to the north of the equator from the south or *vice versa* and become the respective equatorial maritime airs. If in higher latitudes (20° to 25° N) damage or bad weather is reported in terms of dust, or thunderstorms, the passage of an extra-tropical disturbance can be inferred. Even in the Sahara region, some Geographical Expeditions have mentioned of sudden showers and later clearing up, which can only be assigned to passing extra-tropical disturbances.

In news items of the daily papers or radio-broadcasts, mention is generally made of the more destructive typhoons in the China Seas. Sometimes, the item of news may be merely the delaying of the sailing of steamers due to bad weather or the extensive damage to coastal towns or even to seacraft. In all these cases, it is possibly due to the presence of a typhoon in the China Seas. If the report of the typhoon is not too far north of the equator, one can assume that a secondary effect of the typhoon would influence the Indian weather. The idea of excluding typhoons too far north of the equator is to prevent the tropical cyclonic storms and extra-tropical depressions from getting mixed up.

In tropical cyclonic storms, three air masses are involved: (1) Em, the equatorial maritime air which crosses at intervals, under favourable conditions, the equator from the other hemisphere, (2) Tr, a mixed or transitional air containing a mixture of the tropical maritime and tropical continental air in varying proportions and whose ultimate origin should be the north Pacific high and the north Asiatic high, and (3) Tc, the dry continental air, being a mixture of tropical continental air and a small amount of Polar continental air. The first air mass, which has come from the other side of the equator is a bigger determinant of the tropical cyclonic storm than the other two air masses which are available on the same side of the equator as in the tropical cyclonic storm. The presence or existence of these latter two air masses can be assumed as a rule. As Em crosses the equator, not daily, but only at intervals when other conditions are favourable, it can be concluded that the existence of the tropical cyclonic storm, by itself, is an evidence of the favourable conditions for the passage of Em across the equator. The actual conditions have been set out in the book.[2] The Em must have crossed as a 'pulse' from the other side of the equator due to the interposition of a high wedge or ridge across its path and with favourable conditions north of the equator (in case of the northern hemisphere). If the 'pulse' had to cross to the north of the equator due to the interposition of the high ridge, to the west of the ridge a secondary 'pulse' would start in its mainly westward motion to produce the Em of more westerly longitudes. It may cross to the north