

On this system the oven is heated by superheated water, conveyed from a stove through closed pipes, which are coiled round the entire interior of the oven. This oven has the recommendation of perfect cleanness, and the temperature in it is easily regulated; but it is costly in construction, and the method has not commended itself in practice. Among ovens heated from the exterior, that of M. Rolland takes a high place for ingenuity and novelty of construction. Its characteristic peculiarity consists in the possession of a revolving sole, which not only allows the easy introduction and withdrawal of the bread, but the bringing of the different parts regularly and uniformly under the influence of the heat applied. The revolution of the sole is accomplished by a handle worked from the front of the oven; and besides this rotatory motion the sole can also be raised or lowered so as to bring either the upper or under side of the bread close to the heat as desired. The heating of M. Rolland's oven is effected by means of flues, which pass radially under and over the revolving sole. The chief objection urged against this form of oven is, that the air within it becomes too dry, which detracts from the flavour of the loaves fired in it. The use of the Vienna oven is general in Germany, and is extending in Paris for the baking of small or Vienna bread. It is egg-shaped in form, with an inclined sole, a very small aperture, and a low roof.<sup>1</sup> Its average internal dimensions are 12 feet in depth, 10 feet wide, and 18 inches high. In the best of these ovens glazed tiles are used for the sole. The inclination of the sole facilitates the filling and emptying of the oven; and the confined space of the interior retains a large proportion of moisture, which gives a fine colour to the crust and flavour to the crumb of the bread.

**Qualities of Bread.**—The process of baking changes the structure of the crust or outer part of a loaf, and, according to Reichenbach, develops in it a substance termed *assaman*, which he says has an influence in retarding the waste of tissue. It does not alter the starch of the crumb or internal part, but only swells the granules, and by the induced sponginess of the mass renders it readily digestible. Well-baked bread should have a yellowish-brown crust; the crumb should be uniform in texture, permeated with minute cavities, and without "eyes" or large air-cells. The colour of the crumb, unless in the case of whole wheat bread, should be white; it should be free from acidity and sourness. It should keep sweet and eatable for several days; and when stale it will be found to become soft and pleasant by again heating it in an oven, after which, however, it rapidly changes. According to Dr Frankland's determinations, "1 lb of the crumb of bread, if digested and oxidised in the body, will produce an amount of force equal to 1333 tons raised 1 foot high. The maximum of work which it will enable a man to perform is 267 tons raised 1 foot high. 1 lb of crumb of bread can produce, at the maximum,  $1\frac{1}{10}$  oz. of dry muscle or flesh."

The adulteration of bread, and its detection, are treated under the heading **ADULTERATION**, vol. i. p. 170. (J. P. A.) **BAKU**, or **BADKU**, the chief town of the government of the same name, in the Russian province of Transcaucasia (Daghestan), situated in the peninsula of Apsheron, on the west coast of the Caspian, and possessing one of the most spacious and convenient ports in that sea. Long. 49° 53' E., lat. 40° 23' N. It is built in the form of an obtuse triangle, on the slope of an arid hill, and is defended by a double wall and ditch constructed during the reign of Peter the Great. The general appearance of the town is decidedly Oriental, with its flat-roofed houses rising one behind the other, often in so close proximity that the top of the one

<sup>1</sup> The Vienna oven is figured in Knapp's *Technology*, vol. iii. p. 102.

forms the courtyard of the next. The hill is crowned by a castle, which dates from the 15th century, and the mosque of Shah-Abbas, still in good preservation. At the entrance of the harbour stands the Maiden's Tower, now used as a lighthouse, which derives its name from a tragedy like that of the Cenci. Baku is not only a principal station of the Russian fleet, but it carries on a very extensive trade, exporting naphtha, iron, linen, and woollen goods, and receiving in return cotton, grain, fruits, &c. The numerous naphtha wells in the neighbourhood, and the remarkable escape of inflammable gases, rendered Baku a favourite resort of the fire-worshippers, who for long maintained their temples in the district; but, though the natural phenomena display themselves as abundantly as ever, they are now almost entirely deserted by devotees. The Arabian Masudi, in the 10th century, is supposed to be the first to mention "Baki" and its fire-breathing mountain; and the naphtha wells are probably those alluded to by Marco Polo. In 1509 it was taken by the Persians, who lost it to the Turks, but recovered it under Shah-Abbas. Captured by the Russians in 1723, it was restored to Persia in 1735, but after various vicissitudes it was finally incorporated with the Russian empire in 1806. (See Goldschmid's *Telegraph and Travel*, 1874; Filippi's *Viaggio in Persia*, 1865; *Hist. des découvertes faites par div. sav. voyageurs*, Lausanne, 1784; *La Tour du Monde*, 1863; "Baku" in *Zeitschrift der Deutsch. Geol. Gesellsch.*, 1874.)

**BALA**, a market-town of Wales, county of Merioneth, and hundred of Penllyn, at the northern extremity of the lake of the same name, 17 miles N.E. of Dolgelly. It consists principally of one wide street. Its manufactures are flannels, stockings, gloves, and other woollen hosiery. There is an endowed grammar school, founded in 1712, and a theological college, belonging to the Calvinistic Methodists. The Rev. Thomas Charles, well known in connection with the religious literature of his country, was long a minister at Bala. Population, 1539. The Lake of Bala, which is 4 miles long and about half a mile broad, is subject to sudden and sometimes dangerous floods. It is very deep and clear, and abounds with pike, perch, trout, eels, and the *gwyniad*, or *Coregonus fera*.

**BALAAM**, or rather **BILEAM**, the son of Beor, belonging to Pethor, by the River Euphrates in Aram, is represented in Scripture as a seer who possessed the power of blessing and cursing effectually. According to the narrative in Numbers xxii.—xxiv., he was invited by Balak, king of Moab, to come and curse Israel, in order to ensure the latter's defeat. Jehovah, however, forbade him to go as he was requested, and therefore he refused to accompany the deputation of elders, who had been sent to invite him, "with the rewards of divination in their hand." After the arrival of a second embassy more imposing than the first, he received divine permission to go, but only on condition that he should adhere strictly to what Jehovah should tell him. He set out accordingly, and in his journey experienced the anger of the Lord, an angel being sent to stop his progress, who was perceived only by the ass on which the prophet was riding. After Balaam's eyes had been opened he saw the angel, and declared his willingness to go back, but received permission to continue his journey on condition of saying nothing but what was suggested to him by God. His reception by Balak was honourable and imposing, yet he continued faithful to Jehovah, and told the king he would only announce what Jehovah revealed. Standing on the height of Baal-Bamoth, and surveying the tents of Israel, he declared his inability to curse a people so peculiar and righteous. Brought next to the top of Pisgah, and beholding thence a part of the Israelite camp, he announced that Jehovah saw no iniquity or perverseness in Jacob; that He was with them; that they were therefore strong and

victorious. Conducted afterwards to the top of Peor, he surveyed the army of Israel, and predicted their future, their goodly dwellings in Canaan, and their successful wars against the nations down to Saul's time. Though Balak was angry and interrupted him, Balaam continued his prophecy, announcing Israel's valiant deeds, from David down to Hezekiah. Upon this he returned to his home.

Another account of Balaam appears in Numbers xxxi. 8–16, Joshua xiii. 22, where we learn that he advised the Midianite women to seduce the Israelites to the licentious worship of Baal, and that he was slain in a war with the Midianites.

The character given to Balaam in the first account is a favourable one. He is a worshipper of Jehovah the true God, receives divine revelations, and repeatedly declares that he will not go beyond or against them. Faithful to his calling, he steadfastly resists temptations sufficiently powerful, and therefore God communicates His Spirit to him, enabling him to predict the future of Israel.

The second account is unfavourable. In it he appears as a diviner, *קסם*, a heathen seer, who tempted the worshippers of the true God to idolatry. Instead of being a prophet of Jehovah, receiving visions and revelations, a man to whom the Almighty came by night, giving him instructions what to do, he is an immoral soothsayer. Of the two accounts, the latter, brief as it is, seems entitled to greater consideration. The former is elaborate and artificial, the theme being the glorification of the chosen people by the mouth of one of their enemies. An inspired seer from the far distant land of Aram is called in to bless the Israelites. He does so reluctantly, but like a true prophet, announcing nothing but what came to pass. The way in which he is taught the high destiny of the chosen people is instructive. Ignorant at first of Israel's relation to the true God, and thinking they were like others, he was disposed to curse them, but is enlightened, and forcibly impelled to follow the divine revelations. From a heathen *mantis* he is converted into a true prophet by revelations and visions which he cannot resist. The seer is taken to three places in succession, whence he surveys Israel, and utters oracular sayings concerning them. Three times the angel of the Lord stands in the way, and three times the ass is smitten by Balaam. There are four prophetic announcements—xxiii. 7–10, 18–24; xxiv. 3–9, 15–24. The first refers to the separate condition of Israel, their numbers, and their worship of the true God amid the idolatry of the surrounding nations. The second declares that God blesses Israel because there is no iniquity or perverseness in them, that He dwells among them, reveals himself to them, and makes them powerful and victorious. Both these refer to Mosaic times, or at least to times not later than Joshua. But the third announcement has the character of prediction, and refers to future events. Hence Balaam is introduced as a man whose eyes are opened, who hears the words of God, and sees visions of the Almighty. The condition of the people down to the time of Saul is glanced at, their secure settlement in Canaan, and victorious wars with the native races. The fourth prophecy apparently carries down the history to the time of Hezekiah; and a future ruler is distinguished as the star out of Jacob, the sceptre out of Israel, the conqueror of the Moabites and Edomites. The mention of the Kenites and Assyria in ver. 22, the former of whom were allies of Edom, shows, in the opinion of some recent critics, that the writer was acquainted with the Edomite wars under Amaziah and Uzziah, and hoped that the latter power would permanently subjugate the restless Edomites. This would bring the composition down to the first half of the 8th century. Verses 23 and 24 are obscure, but probably refer to no event later than

Hezekiah. A fleet from the Phœnician Cyprians seems to have attacked the Canaanitish and Phœnician coasts, threatening the Syrians farther north.

The writer of Num. xxxi. 8, 16, Joshua xiii. 22, is the Elohist, whose account is very brief. Meagre, however, as it is, it is probably historical. A heathen soothsayer, connected with the Midianites, perished in one of their battles with Israel. The writer of Numbers xxii.—xxiv. is, in this view, the Jehovist, who, under the name of Balaam, gives expression to his ideas and hopes in the elevated diction of an inspired prophet. As Jacob and Moses had pronounced blessings on Israel under the immediate inspiration of the Almighty, so Balaam is summoned from a distant land to eulogise the same people.

The character of Balaam has been apprehended very variously. Such diversity must exist according as the Elohist or Jehovist is followed. The Old Testament writers who mentioned him afterwards were influenced by the Jehovistic notice, and pronounce no judgment upon the seer (Deut. xxiii. 5, 6; Joshua xxiv. 9, 10; Micah vi. 5; Nehemiah xiii. 2); but the New Testament authors followed the Elohist account, and speak of him disparagingly, attributing to him love of "the wages of unrighteousness," madness, idolatrousness, and impiety (2 Peter ii. 15, 16; Jude 11; Rev. ii. 14). Josephus calls him *μάντις ἀπίστος τῶν ῥήτων*, "the best prophet of his time," supposing him to be a prophet of the true God, but with a disposition ill-adapted to resist temptation. Philo describes his character more critically: "There was a man at that time celebrated for divination, who lived in Mesopotamia, and was an adept in all the forms of the divining art; but in no branch was he more admired than in augury; to many persons, and on many occasions, he gave great and astounding proofs of his skill. For to some he foretold storms in the height of summer; to others drought and heat in the depth of winter; to some scarcity succeeding a fruitful year, and then again abundance after scarcity; to others the overflowing and drying up of rivers, and the remedies of pestilential diseases, and a vast multitude of other things, each of which he acquired great fame for predicting." The unfavourable character drawn of him by Philo is that which is generally taken by the later Jews. The later Targumists call him a sinner and an accursed man, while the Talmudists make him the representative of the godless, in contrast with Abraham, the representative of the pious. Yet they do not ignore his prophetic gift. The Midrashim about him are hardly worth mentioning, such as that he was one of Pharaoh's counsellors, that he was governor of a city in Ethiopia which he excited to rebellion, but was unable to defend against Moses at the head of an army who stormed the place and put Balaam to flight. In Yalkut (§ She-moth) he is said to have been identified by some with Laban, Jacob's father-in-law; by others with Elihu, Job's friend; while others say that Jannes and Jambres were his sons. In Sanhedrin (§ Chelek) he is said to have been blind of an eye. These, and other rabbinical fables, are entirely worthless; and Origen's belief that the Magi from Persia, who came to worship the infant King of the Jews, learnt the meaning of the star from Balaam's prophecies, is of the same character.<sup>1</sup>

Most of the Fathers, including Augustine and Ambrose, judged him to be a soothsayer or magician, a prophet inspired by the devil. A few, as Tertullian and Jerome, took a more favourable view of his character. The Mahometans have various fables concerning Balaam. They say that he was of the race of Anakim, or giants of Palestine, and that he read the books of Abraham, where he got the name Jehovah, by virtue of which he predicted the

<sup>1</sup> See Fabricius's *Codex Pseudepigraphus Vet. Test.*, p. 807, &c.

future, and got from God whatever he asked. This procured him great renown. In consequence, however, of his prevarication, God was offended with him, and left him to himself, so that he fell into infidelity. It is generally supposed that the words in the Koran (§ Al-Araf) refer to him:—"The history of him unto whom we brought our signs and he departed from them; wherefore Satan followed him, and he became one of those who were seduced. And if we had pleased, we had surely raised him thereby unto wisdom; but he inclined unto the earth, and followed his own desire. Wherefore his likeness is as the likeness of a dog, which, if thou drive him away, putteth forth his tongue; or if thou let him alone, putteth forth his tongue also."

It has been conjectured with much probability that the Arabic wise man, commonly called Lokman, is identical with Balaam. The two names coincide in meaning, *devourer, swallower*; and the names of their fathers are also alike. The Jews suppose Balaam to have been a Nahorite, and so Lokman is regarded by many Arabic authors, though the more general opinion is that he was an Abyssinian slave who lived in the time of David, and was renowned as a Hakim. The proverbs or fables attributed to him are of Greek origin.

Modern critics are divided in opinion respecting him. Three leading views embrace the varieties of belief as to his true position, viz., that he was an idolater and soothsayer, whose soul was uninfluenced by true religion—a sorcerer who had acquired reputation by his insight into the force of nature and his incantations; that he was a true prophet of God, a pious man who fell through covetousness; and that he was a heathen soothsayer and a prophet of Jehovah at the same time, occupying an intermediate position, with an incipient knowledge and fear of God, needing but to be developed, though checked by the love of gain. It appears impossible to arrive at a definite or comprehensive view of one who is described in different sources inconsistently. Bishop Butler, not recognising that the history of Balaam has poetical elements, and that different traditions are given respecting him, considers him a very wicked man under a deep sense of God and religion, persisting still in his wickedness, and preferring the wages of unrighteousness even when he had before him a lively view of death. His mind was distracted by contradictory principles of action. All we know about him amounts to very little. After admitting that a heathen soothsayer of this name existed in Mesopotamia, and had acquired some renown in the regions adjoining, and that he was employed in some way as a medium for uttering eulogiums upon Israel, of whose pre-eminence and permanence he is fully conscious, nothing else can be affirmed with certainty. (Davidson's *Introduction to the Old Testament*, vol. i. p. 328, &c.; Ewald's *Geschichte des Volkes Israel*, zweyter Band, p. 298, &c., 3d edition, and his *Jahrbücher*, part 8, p. 1, &c.; Kurtz's *Geschichte des alten Bundes*, zweyter Band, p. 454, &c.; Hengstenberg's *Die Geschichte Bileam's und seine Weissagungen*, 1842; Winer's *Realwörterbuch*, s.v. "Bileam;" Knobel's *Die Bücher Numeri, Deuteronomium, und Josua erklärt*, p. 121, &c.; Schenkel's *Bibel-Lexicon*, s.v. "Bileam;" and Hamburger's *Real-Encyclopædie für Bibel und Talmud*, s.v. "Bileam.")

BALÁGHÁT, a British district in the Central Provinces of India, situated between 21° and 23° N. lat. and 80° and

<sup>1</sup> מַלְאָךְ from מַלְאָךְ, with the formative letter D. It has been derived from מַלְאָךְ (Sanhed. 105), *destroyer* or *corrupter of the people*, so that the name has passed for a typical designation of Israel's enemy; and this is reflected in the Greek word Νικολάτης (Rev. ii. 6), from νικᾶν and λαός, as if the Nicolaitanes were essentially Balaamites, or seducers. But this etymology of the name Balaam is improbable.

81° E. long.; bounded on the N. by the district of Mandla; on the E. by the district of Chhattisgarh; on the S. by Chhattisgarh and Bhandára; and on the W. by the district of Seoni. Balághát forms the eastern portion of the central plateau which divides the province from east to west. These highlands, formerly known as the Raigarh Bichhiá tract, remained desolate and neglected until 1866, when the district of Balághát was formed, and the country opened to the industrious and enterprising peasantry of the Waingangá valley. Geographically the district is divided into three distinct parts:—(1.) The southern lowlands, a slightly undulating plain, comparatively well cultivated, and drained by the Waingangá, Bágh, Deo, Ghisri, and Son rivers. (2.) The long narrow valley, known as the Mau Taluká, lying between the hills and the Waingangá river, and comprising a long, narrow, irregular-shaped lowland tract, intersected by hill ranges and peaks covered with dense jungle, and running generally from north to south. (3.) The lofty plateau, in which is situated the Raigarh Bichhiá tract, comprising irregular ranges of hills, broken into numerous valleys, and generally running from east to west. The highest points in the hills of the district are as follows:—Peaks above Lánj, 2300 or 2500 feet; Tepágarh hill, about 2600 feet; and Bhainsághát range, about 3000 feet above the sea. The principal rivers in the district are the Waingangá, and its tributaries, the Bágh, Nahrá, and Uskál; a few smaller streams, such as the Masmár, the Máhkárá, &c.; and the Banjár, Hálon, and Jamuniá, tributaries of the Narbadá, which drain a portion of the upper plateau. Balághát contains very extensive forests, but they do not produce timber of any great value. They teem with wild animals, from the great bison to the fox; 470 beasts and venomous snakes were killed in 1867-68, a total reward of £156 being paid under this head. The district contained in 1868 an assessed area of 1462.08 square miles or 935,731 acres, of which 214,587 acres were under cultivation; 488,510 grazing lands; 116,938 culturable, but not actually under cultivation; 115,696 unculturable waste. The census report of 1872 returned the area at 2608 square miles. The census of 1866 showed a population of 170,964. This had in 1872 increased to 195,008, residing in 37,192 houses and 781 villages; average number of persons per square mile, 74.77; per village, 249.69; per house, 5.24. Of the total population, 131,176 or 67.27 per cent. were Hindus; 2934 or 1.50 per cent. Mahometans; 39 Buddhists; 11 Christians; 60,848 or 31.20 per cent. of unspecified religions of aboriginal or imperfectly Hinduised types.

Since 1867 considerable encouragement has been given to the cultivating tribes of Ponwárs, Kunbís, Marárs, &c., of the low country to immigrate, and take up lands in the upland tracts. By this means a large quantity of jungle lands has lately come under cultivation. The acreage under the principal crops grown in the district is returned as follows:—rice, 188,312 acres; wheat, 585; other food grains, 8770; oil-seeds, 3436; sugar, 505; fibres, 100; tobacco, 638; total, 202,346 acres. Iron is smelted by the Gonds; gold exists in the beds of some of the rivers, but not in sufficient quantities to repay the labour of washing. There are no regularly made roads in the district. Five passes lead from the low country to the highlands, viz., the Bánpur Ghát, the Warai Ghát, the Pancherá Ghát, the Bhondwá Ghát, and the Ahmadpur Ghát. For revenue purposes the district is divided into two subdivisions, the Búrhá Tahsil and the Paraswára Tahsil. In 1868-69 the total revenue of the Balághát district amounted to £11,746, of which £6754, or 57 per cent., was from land. For the protection of person and property, Government maintained, in 1868, 115 policemen, at a total cost of £1156, 16s. In 1868 only two towns in the dis-

trict had upwards of 2000 inhabitants, viz., Hattá, population, 2608, and Lanj, population, 2116. About 60 years ago the upper part of the district was an impenetrable waste. About that time one Lachhman Náik established the first villages on the Paraswára plateau, on which there are about 30 flourishing settlements. But a handsome Buddhist temple of cut stone, belonging to some remote period, is suggestive of a civilization which had disappeared before historic times.

**BALANCE.** For the measurement of the "mass" of (*i.e.*, of the quantity of matter contained in) a given body we possess only *one* method, which, being independent of any supposition regarding the nature of the matter to be measured, is of perfectly general applicability. The method—to give it at once in its customary form—consists in this, that after having fixed upon a *unit mass*, and procured a sufficiently complete set of bodies representing each a known number of mass-units (a "set of weights"), we determine the ratio of the *weight* of the body under examination to the *weight* of the unit piece of the set, and identify this ratio with the ratio of the *masses*. Machines constructed for this particular *modus* of weighing are called *balances*. Evidently the weight of a body as determined by means of a balance—and it is in this sense that the term is always used in everyday life, and also in certain sciences, as, for instance, in chemistry—is independent of the magnitude of the force of gravity; what the merchant (or chemist) calls, say, a "pound" of gold is the same at the bottom as it is at the top of Mont Blanc, although its real weight, *i.e.*, the force with which it tends to fall, is greater in the former than it is in the latter case.

To any person acquainted with the elements of mechanics, numerous ideal contrivances for ascertaining which of two bodies is the heavier, and for even determining the ratio of their weights, will readily suggest themselves; but there would be no use in our noticing any of these many conceivable balances, except those which have been actually realised and successfully employed. These may be conveniently arranged under six heads.

1. *Spring Balances.*—The general principle of this class of balances is that when an elastic body is acted upon by a weight suspended from it, it undergoes a change of form, which, *ceteris paribus*, is the greater the greater the weight. The simplest form of the spring balance is a straight spiral of hard steel (or other kind of elastic) wire, suspended by its upper end from a fixed point, and having its lower end bent into a hook, from which, by means of another hook crossing the first, the body to be weighed is suspended, matters being arranged so that even in the empty instrument the axis of the spiral is a plumb-line. Supposing a body to be suspended at the lower hook, it is clear that the point where the hooks intersect each other will descend from the level it originally occupied, and that it must fall through a certain height *h* before it can, by itself, remain at rest. This height, provided the spiral was not strained beyond its limit of elasticity (*i.e.*, into a permanent change of form), is proportional to the *weight* *P* of the body, and consequently has to the mass *M* the relation  $h = c/gM$ , where *c* is a constant and *g* the acceleration of gravity. Hence, supposing in a first case *h* and *M* to have been *h'* and *M'*, and in a second case, *h''* and *M''*, we have  $h' : h'' :: gM' : gM''$ ; and it is only as long as *g* is the same that we can say  $h' : h'' :: M' : M''$ . Spring balances are very extensively used for the weighing of the cheaper articles of commerce and other purposes, where a high degree of precision is not required. In this class of instruments, to combine compactness with relatively considerable range, the spring is generally made rather strong; and sometimes the exactitude of the reading is increased by inserting, between the index and that point the displacement of which serves

to measure the weight, a system of levers or toothed wheels, constructed so as to magnify into convenient visibility the displacement corresponding to the least difference of weight to be determined. Attempts to convert the spring balance into a precision instrument have scarcely ever been made; the only case in point known to the writer is that of an elegant little instrument constructed by Professor Jolly, of Munich, for the determination of the specific gravity of solids by immersion, which consists of a long steel-wire spiral, suspended in front of a vertical strip of silvered glass bearing a millimetre scale. To read off the position of equilibrium of the index on the scale, the observing eye is placed in such a position that the eye, its image in the glass, and the index are in a line, and the point on the scale noted down with which the index apparently coincides.

2. *Chain Balances.*—This invention of Wilhelm Weber's having never, so far as we know, found its way into actual practice, we confine ourselves to an illustration of its principle. Imagine a flexible string to have its two ends attached to the two fixed points C and D (fig. 1), forming the ter-

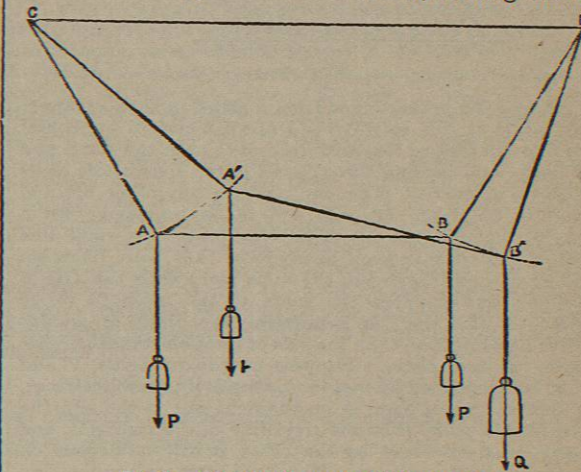


FIG. 1.—Diagram illustrating Chain Balance.

minal points of a horizontal line CD shorter than the string. Suppose two weights to be suspended, the one at a point A, the other at a point B of the string; the form of the polygon CDBA will depend, *ceteris paribus*, on the ratio of the two weights. Assuming, for simplicity's sake, CA to be equal to DB, then, if the weights are equal, say, each = *P* units, the line AB will be horizontal. But if now, say, the weight at B be replaced by a heavier weight *Q*, the point A will ascend through a height *h*, the point B will descend through a lesser height *h'* in accordance with equation  $P h = Q h'$ , and the angle between what is now the position of rest of the base line A'B', and the original line AB will depend on the ratio of *P* : *Q*. The exact measurement of this angle would be difficult, but it would be easy to devise very exact means for ascertaining whether or not it was horizontal, and, if not, whether it slanted down the one way or the other; and thus the instrument might serve to determine whether *P* was equal to, or greater or less than, *Q*; and this obviously is all that is required to convert the contrivance into an exact balance.

3. *Lever Balances.*—This class of balances, being more extensively used than any other, forms the most important division of our subject. There is a great variety of lever balances; but they are all founded upon the same principles, and it is consequently expedient to begin by summing up these into one general theory.