# THE MOND NICKEL COMPANY'S 25TH ANNIVERSARY MEDAL

1900-1925



*Struck in Pure Nickel*

*THE figure depicted on the obverse of the medal symbolizes the element Nickel. The word "Nickel" originally signified "mischievous, or obstinate, demon." In this sense it was applied by the medieval miners of Central Europe to niccolite—an arsenical nickel ore which, being red-coloured, they mistook for copper ore, and opprobriously called it Kupfer-nickel. The word "Nickel" was subsequently adopted for the element by Cronsted when he succeeded in isolating it from niccolite in 1751. The Latin inscription, taken from Ovid, means—"Then for the first time a winged thing sprang aloft"—the allusion being to the discovery made by the late Dr. Ludwig Mond, F.R.S., and Dr. Langer that Nickel could be refined by volatilization. It will be observed that the figure symbolizing "Nickel" is tossing Mond nickel pellets from one hand to the other. The maple leaves and daffodils on the reverse of the medal are emblematic of Canada and Wales.*

# NICKEL COINAGE

*by*

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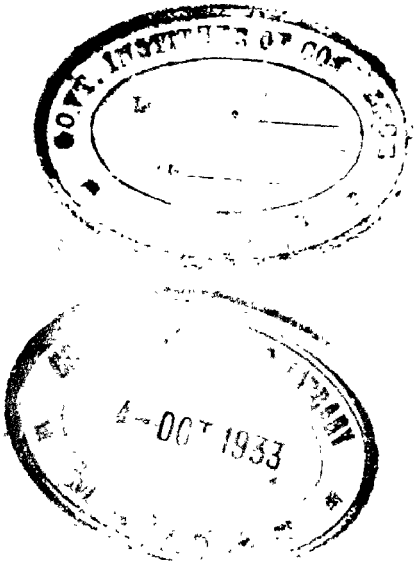


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# *Preface*

*MODERN systems of currency have all been evolved from a state of barter. In the primitive ages, before the idea had been conceived of establishing units of value, if a man desired to obtain, let us say, an ox, he might endeavour to effect an exchange for it by offering the owner an object of approximately equivalent value, such as a bronze axe or hoe; but to complete the bargain one or the other party would, as likely as not, find it necessary to throw in his wolf-skin vest, or some other prized possession. Bartering, in fact, was a practice attended by many inconveniences, delays, and limitations. Either the desired objects of exchange were not always available when wanted, or there was difficulty in coming to an agreement upon the equality of the values of the articles proffered in exchange. A custom beset with so many drawbacks could not be maintained for long in a progressive world, and so it gradually came to pass very early in the history of civilisation that mankind hit upon the expedient of employing metals as convenient units of value. The great advantages which the use of metals gave for this purpose were their portability, their permanence, and the fact that they could be divided into small quantities without loss of intrinsic value. The three metals then available which conformed best to these conditions were gold, silver, and copper; and these accordingly in course of time became recognised as the chief money materials. Units composed of these metals originally passed by their size or by trial of weight; in the next phase of the evolution of money the quality or fineness of the metal was stamped upon them, and this practice after a time was followed by the rule of certifying the weight by an impress. With the gradual improvement in the organisation of states the necessity arose to enforce contracts, an obligation which carried with it that of providing standards of payment under a regulating authority. And so by degrees the manufacture and issue of metal units of exchange became a monopoly of the governing authority of the state, and units were stamped with designs or*

*effigies to certify their official origin. The earliest types of such coins had various forms, but at last the universally accepted shape was that of the flat circle, devised by the ancient Greeks.*

*Coming down to more recent times, modern money, speaking broadly, consists of two kinds—standard money and token money. Regarded as currency, the plain difference between them is one of degree in their capacity to liquidate debts, standard money possessing full liberating power to discharge debts, while token money proffered with that intent is limited by law to a specified amount.*

*The standard unit of value in Great Britain is the pound sterling, which contains a definite quantity of pure gold, and gold being a metal which is not subject to wide fluctuations in price, the intrinsic value of the coin is practically constant. Our gold money (or its equivalent in Treasury notes) is therefore constituted legal tender to any amount. The purchasing or liberating power of token money, on the other hand, is not based upon its intrinsic value, but is derived from its relation to the standard unit—the pound sterling; and its capacity to discharge debt is limited in the case of silver money to forty shillings, and in the case of bronze money to one shilling.*

*This monetary expedient, which is known as the "composite legal tender" system, originated in England, and its principles were first formally adopted in the Coinage Act of* 1816.

*Although the silver coinage of the realm was definitely reduced by that Act of Parliament to the status of subsidiary money by prescribing a limit to its legal tender, the monetary authorities of those days, and even as late as* 1870, *when the Consolidating Coinage Act was passed, were chary of curtailing the intrinsic value of our silver coins much beyond the figure of the cost of their manufacture. It was therefore enacted by both these laws that one ounce of standard silver* (i.e., *silver* 925/1000*ths fine*) *should be coined into* 5s. 6d. *worth silver coins, and as the gold price of silver between* 1816 *and* 1870 *remained nearly constant round about* 60d. *an ounce, the difference between the actual and nominal*

*values of the coins was approximately 10 per cent. The subsequent decline in the intrinsic value of our silver money, which began in 1872, was solely due to the gradual fall in the gold price of silver. In 1913 the average price of the metal had fallen to 27½d. an ounce, and the actual value of the shilling was then exactly 5d. Since that time the disparity between the two values has grown still wider, a condition which is due, however, not to a further fall in price of the metal, but to consequences that arose from its phenomenal price in 1919 and 1920, when it soared up to 89½d. "This meant," to quote from the Royal Mint Report for 1920/21, "that it would cost 3s. 4d. in silver alone to produce one half-crown, and, moreover, that holders of British silver coins could, if they melted them down, get considerably more than their face value for the bullion they contained." The dilemma was met by hurriedly passing the Silver Coinage Amending Act of 1920, under which the millesimal fineness of the silver coins was reduced from 925 to 500. But the Act had no sooner come into force than the price of silver began steadily to decline again. At the time of writing[1] it stands at about 25d., and the millesimal fineness of the coinage being only 500, the intrinsic value of our present shilling is less than 2½d. The disparity, therefore, between actual and face values of our silver coins, which was formerly 10 per cent., is now nearly 80 per cent.*

*There is nothing abnormal in this wide inequality of values of our silver token money. Neither the national credit nor the price of commodities is affected by it. Provided in fact that the metal of which token coins are made is of a kind which defies successful counterfeiture, the lower the intrinsic value of token money as compared with its nominal value, the greater is the relief to the taxpayers, for the profit made by the Royal Mint on our token money is by law paid into the Consolidated Fund at the Exchequer. But people of all classes of every nation are peculiarly conservative in regard to money. In our own country, for instance, notwithstanding that every nook and corner of the commonalty is being explored for sources of fresh taxation or for the detection of needless expenditure, we yet desperately endeavour to maintain, at*

(1) October, 1926.

*great cost, the tradition of our silver coinage by disguising an expensive yellow alloy, half silver and half copper, to look like the genuine metal ; an artifice which is achieved chemically by coating the yellow body of the coins with an extremely thin and transitory film of pure silver. In other words, though we deprecate luxury of every kind, we blindly indulge our conservative instinct by maintaining at heavy expense an unsatisfactory imitation of our former silver currency.*

*In these circumstances it may well be asked whether there is any other metal which could be employed to provide us with better coins and at the same time enable a reduction to be made in public expenditure. An answer to this question is not far to seek, for it is now acknowledged by coinage specialists throughout the world that the ideal metal for token money is pure nickel, the raw material cost of which at present prices is about one twentieth that of standard silver. The high melting point of nickel and the technical difficulties and expense incidental to casting and rolling it are insuperable obstacles to the production of pure nickel coins by unauthorised persons ; while spurious coins made of some other metal or alloy to imitate nickel are distinguishable at a glance from genuine money. And if a further safeguard were necessary, it is provided by the fact that pure nickel is the only metal, saving iron and cobalt, which is magnetic.*

*The stages by which pure nickel has been promoted to the paramount position among the base metals for token coinage are set forth chronologically in the following pages, and the reader of them will incidentally observe why the delusive notion, under which it was deemed necessary to approximate the actual and nominal values of token money, is gradually giving way to a more enlightened conception.*

*Seeing that the process of manufacturing pure nickel money differs widely in its early stages from that employed in making gold, silver, copper-nickel and bronze coins, a short description of the origin and manufacture of a nickel coin is given as an appendix to this pamphlet.*

*F.R.B.*

# *History of*
# *NICKEL COINAGE*

*Bactria, 235 B.C*

AS far as our present knowledge goes, the first people to make use of nickel in coinage were the Bactrians. This ancient Asiatic race, who inhabited the territory north of the great Hindu-Kush range of mountains, now known as Russian Turkestan, came under the influence of Greek culture as a result of the conquest of Bactria by Alexander the Great, and for the space of about a century the art of their coins reached a remarkably high state of excellence. Among the Bactrian coins issued during that period, there is one type bearing the effigy of King Euthydemus II. (B.C. 235) which is composed of an alloy of copper and nickel containing about 77 per cent. copper and 20 per cent. nickel. A detailed analysis of one of these coins weighing 5·266 grams, now in the collection of the British Museum, gave the following result :—(1)

| | |
|---|---|
| Copper . . . | 77·585 per cent. |
| Nickel . . . . | 20·038 ,, |
| Cobalt . . . . | 0·544 ,, |
| Iron . . . . | 1·048 ,, |
| Tin . . . . | 0·038 ,, |
| Silver . . . . | Trace. |
| Sulphur . . . | 0·090 per cent. |

The composition of this ancient money affords matter for interesting speculation. The first question for consideration is whether the Bactrians are themselves likely to have possessed the knowledge requisite to producing such an alloy. And assuming that they had acquired this knowledge, another question arises : Where did they obtain the ore from which the metal is derived ?

It is quite safe to premise that the alloy was not manufactured by fusing together isolated quantities of nickel

(1) " Numismatic Chronicle " (Flight), Vol. 8 (1868), p. 307.

and copper, for isolated nickel in a native or elemental state does not occur, and the knowledge that it is a separable element was not discovered until 2,000 years later. We must assume therefore that the Bactrian metal was a natural alloy, derived by direct smelting of a complex ore ; and in the face of the above analysis there can be no doubt that it belonged to the type known as nickel sulphide ores, which are usually rich in copper and iron.

So far as is known there are no deposits of nickel sulphide ores in, or near, the region the Bactrians inhabited. It has been suggested[1] that the coin metal ore was obtained from Kandahar in Afghanistan, where nickel in small quantities is said to be present[2] in the gold-bearing lodes of that vicinity ; but this is obviously not the same type of ore as that indicated by the analysis quoted. Proceeding therefore on the assumption that the Bactrians dug and smelted the ore themselves, the inference seems to be that the deposit from which they obtained it became exhausted, and that all trace of the deposit has consequently disappeared. This hypothesis would at least account for the remarkable fact that the art of preparing so useful and ornamental a metallic alloy as copper-nickel became extinct in Western Asia.

A theory has been advanced that the smelting operation employed by the Bactrians was similar in method to that followed some sixty years ago for smelting nickel in Sweden.[3] Under this method a magnetic pyrites, containing sulphides of copper, nickel, and iron was roasted in heaps and then mixed with quartz and smelted. The iron oxidised by the roasting passed away with the salicic acid in the form of a slag and a matte of copper and nickel was obtained. This was broken up, roasted in a reverberatory furnace, and then fused again, and after having been subjected to several repetitions of these processes, a matte was obtained which resulted in an alloy of 70 to 80 per cent. of nickel, 18 to 22 per cent. of copper, and 1·5 to 2·5 per cent. of iron.

(1) Flight op. cit.
(2) Imp : Gazetteer of India, vol. 5, p. 55.
(3) Flight op. cit.

It is scarcely conceivable that a process so complex was known to the Græco-Bactrians, involving as it does not only considerable metallurgical knowledge, but also the principle and use of the reverberatory type of furnace. We should be on safer ground if we supposed that the ore was smelted by means of some simple form of hearth furnace, with charcoal for fuel and combustion urged by hand-bellows, such as the early Egyptians and the Etruscans are known to have used for smelting iron. The objection, however, to accepting the latter suggestion is that it is difficult to understand how, by this primitive means of smelting, the sulphur and other serious impurities in the pyritic ore could have been sufficiently eliminated.

In view of the many difficulties which beset the assumption that the metal was produced locally, it is permissible to put forward a new theoretical solution to the puzzle. May it not be possible that the metal was imported into Bactria in a prepared form from China by overland route ?

It is a matter of common knowledge that the Chinese were exceedingly skilful at a very early period in the art of reducing metallic ores, and in melting and casting metals so obtained. At least as long ago as the Han dynasty (221 B.C.–A.D. 25), and probably much earlier, they manufactured an alloy from copper nickel ore, called in Chinese " pei-tung " (white copper). An analysis of a specimen of " white copper " from China gave the following result :—(1)

| | |
|---|---|
| Copper . . . . | 79·4 per cent. |
| Nickel . . . . | 16·02 ,, |
| Iron . . . . | 4·58 ,, |

a composition, it will be observed, which bears a strong resemblance to that of the Bactrian coin. The sulphide ore from which " white copper " was obtained is known to have been mined and smelted in the Chinese provinces of Yunan and Szechwan.

Now, it is recorded in ancient Chinese annals that an overland caravan route between China and Bactria was in

(1) Traité de Chimie (3rd Ed.) III. p. 1030.

existence in the early part of the 2nd century B.C. This route remained open for many years, and then became closed for a century or more owing to the invasion of turbulent Mongolian tribes who at that period overran Central Asia and eventually advanced into Bactria in 139 B.C. and took possession of the country. There is ample written testimony in ancient literature to establish the fact that while the overland route remained open a brisk trade in silk and other commodities was maintained between China and the Mediterranean littoral, Bactria being the *entrepôt* where the two trade currents, from East and West, met.

On the support afforded by these historical data, the surmise is now adduced that one of the articles of trade taken westward by the Chinese consisted of ingots of the copper nickel alloy, and that the composite metal was bartered to the Græco-Bactrians, who manufactured it into coins. Proceeding on this hypothesis, we are no longer confronted with the difficulty of assuming the existence and subsequent disappearance of deposits of nickel sulphide ores in Bactria; and the closing of the overland trade route due to the Mongol invasion during the 1st Century B.C. would account for the cessation of minting copper nickel coins by the Græco-Bactrians.

It must be added that the validity of the theory depends to a certain extent on a chronological assumption. The original overland route between China and Bactria is said, according to Chinese annals, to have been established in the year 188 B.C. But as the date of the Bactrian copper nickel coins is put round about 235 B.C., we should have to assume, to justify the theory, that communication existed between the two countries about 50 years earlier than the Chinese annals indicate.

We may now hazard a conjecture as to the means the Bactrians employed for making the metal into coins. In the first place, to melt and cast the metal the high temperature of approximately 1,400° C. would be required.

They probably employed for the purpose a simple form of hearth furnace, which is the principle of the blacksmith's forge and is the oldest of metallurgical contrivances. The required degree of heat having been raised and maintained by violent and unintermittent labour at the bellows for several hours, the molten metal was run into clay or stone moulds of lenticular shape. The castings or so-called " coin-blanks " thus produced were subsequently made red-hot to render them soft, and were placed one by one upon a bronze die fixed into an anvil. A reverse die held by tongs having then been placed upon the upper surface of each heated blank, a single hard blow was brought down upon the top die by a heavy hammer. The result was a coin more or less round in shape, frequently split open at the edge, with clear and artistic designs in high relief on the obverse and reverse. Some of the existing Bactrian copper-nickel coins are almost as white as silver. They have the head of the reigning king in profile on one side, and a tripod on the other.

* * * *

*Switzerland, 1850.*

Two thousand years elapsed before nickel was again employed for coinage purposes, and this time it was by Switzerland. The first Swiss nickel alloy coinages sprang indirectly—as we shall now proceed to show—from the Chinese precedent " pei-tung."

" Pei-tung " was, as already stated, a natural alloy derived direct from a complex ore. It is improbable that the Chinese used the metal in its natural state to any large extent in the arts or handicrafts, and it was certainly not used, at any rate in early times, for Chinese money. Apart from the fact that copper-nickel alloys containing 15 per cent. or more of nickel are very hard, they are apt to be brittle owing to absorption of oxygen, sulphur, or carbon during the melting operation, and any but quite small castings made of the metal containing these impurities would almost inevitably be so faulty as to be worthless.

The Chinese, however, with their proverbial utilitarian intuition, surmounted the difficulty by the expedient of adding zinc to the composition, the effect of which is to give the metal a whiter colour and to render it more easy to manipulate.[1] The simple copper-nickel alloy was sent down to the coast in the shape of " triangular rings," where it was fused or melted with zinc to form a ternary alloy[2] called in the Cantonese dialect " pak-tong," this being a variant of the word " pei-tung," meaning white copper. The resulting product is a ductile metal which we know under the name of German silver, or Nickel silver. No serious difficulty is encountered in producing sound castings of this metal, and it was manufactured by the Chinese into various kinds of household utensils.

A specimen piece of paktong brought from the East in 1776 was examined by Engestroem, the celebrated Swedish chemist, who pronounced it to be an alloy of nickel, copper, and zinc in the following proportions :—Nickel 15·63 per cent., copper 43·75 per cent., zinc 40·62 per cent., together with a small quantity of cobalt. Engestroem thereupon recommended the carrying out of some alloying experiments on copper-nickel derived from Swedish ore deposits by direct smelting with a view to ascertaining how much zinc should be added to it in order to form, as he said, " a real paktong." Whatever the result of these experiments (if undertaken) may have been, they do not appear to have given rise to the manufacture of the alloy in commercial quantities. It was not until nearly 50 years afterwards that refining operations to separate nickel were begun on a commercial scale, and as soon as the refined metal thus became obtainable the manufacture of the alloy was taken in hand both in England and in Germany Among the German silver alloys was one produced by Dr. Geitner, a chemical manufacturer at Schneeburg in Saxony, to which he gave the name of " Argentan." Its composition was copper 8 parts, nickel 2 parts, zinc 3 parts. In course of time this metal became a popular substitute for silver in the manufacture of articles for

(1) *At what period in their history the Chinese began to make this ternary alloy is an undetermined question.*
(2) " *Tutenag and Paktong* " (1924), *p.* 30 (*Bonin*).

household use, and in 1850 it was adopted by the Swiss as the basis of a new coinage.

Shortly prior to that date, certain changes had been made in the constitution of the Swiss Federal Government, one of which was that the cantons were no longer independent entities with power to issue their own coinage, but became subject to a centralised Federal Government. A commission which was appointed to make recommendations for a new Federal " billon "[1] coinage reported in 1850 as follows :—

" It is well known that Argentan (Neusilber), a metal consisting of copper, zinc, and nickel, has recently come much into use. The beauty of this metal approaches that of 12 alloy silver, which it exceeds, moreover, in hardness and durability. It is not subject to oxidation, and retains its white colour in the wear and tear of use. The time is now ripe to make use of these advantages for billon coins by substituting a part of the copper content with silver, and experiments which have been made, resulting in samples now before the commission, indicate the value and practicability of the idea. By means of this method, billon coins may be produced which, instead of becoming red with age, or green with verdegris after being for long laid aside, will retain their whiteness and lustre ; and their remarkable hardness will not only retard abrasion, but will also impose an obstacle to counterfeiture, for the reason that they can only be minted by machines of great power.

" Nickel is, however, a somewhat rare metal, though the cost of it cannot be said to be very high, its price being about eight-fold that of copper. Nickel is chiefly obtained in Austria, and its present price is Fl. 4 to Fl. 4·30 Kreuzer per Vienna pound .

Following the Commission of Enquiry's Report the Swiss Coinage Law of 7th May, 1850, was passed, which provided for the minting and issue of token coins of the

(1) *" Billon " is a term applied on the Continent of Europe to the base metal of some coins. " Billon " originally contained about 1/5th silver to 4/5ths copper, but the term has persisted to the present time in France and Switzerland, notwithstanding that so-called " billon " coins in current use contain no silver.*

following weights and silver contents. The base metal contents were not specified by law :—

| Coin. | Weight, grams. | Copper, per cent. | Nickel, per cent. | Zinc, per cent. | Silver, per cent. |
|---|---|---|---|---|---|
| 20 rappen | 3·25 | 50 | 10 | 25 | 15 |
| 10 „ | 2·50 | 55 | 10 | 25 | 10 |
| 5 „ | 1·66 | 60 | 10 | 25 | 5 |

The object aimed at by adding silver to the alloy was that of reconciling, as far as possible, the nominal and actual values of the metals of which the coins were composed ; an unnecessary and wasteful compromise in the case of token coins.

In those days the Swiss Federation possessed no Government minting establishment, and the first order for the required supplies, comprising about 45 million coins, was given to the French Mint at Strasbourg. The favourable indications afforded by the experiments made in producing the new type of coins were not borne out in practice. Unexpected difficulties were encountered in melting and rolling the metal, and its extreme hardness resulted in unusual wear and tear of rolling and minting machinery and the breaking of many coining dies. The coins, moreover, were imperfect, the impression being shallow, and the metal lacking lustre.

In 1855 a Federal Mint was established at Berne, and the Director thereof received instructions to produce coins of the same type and composition, but when it was attempted to comply therewith, he soon became convinced that the alloy was unsuitable for coinage purposes. He attributed the great hardness of the metal to an excessive proportion of nickel, and endeavoured to correct this fault by altering the base metals' content of the 20 rappen coins as follows, leaving, perforce, the statutory silver content unaltered :—

| Copper, per cent. | Nickel, per cent. | Zinc, per cent. | Silver, per cent. |
|---|---|---|---|
| 75 | 5 | 5 | 15 |

But these coins, which were issued in 1858, were also unsatisfactory, being still too hard, and, what was worse, they assumed, owing to the preponderance of copper in

the mixture, an unsightly reddish colour and became oxidised.

Bearing in mind that the Swiss Mint authorities were bound by the law of 1850 to put specified proportions of silver into the coins, they were justified in imputing the hard and brittle nature of the alloys to the nickel ingredient. But the fault was actually as much due to the silver as to the nickel content. The German silver alloy, "Argentan," is a ductile metal, but by adding silver thereto it becomes hard and intractable, the reason being that nickel and silver cannot be fused into a uniform mixture. The same difficulty was encountered at the Royal Mint in London as recently as the year 1920, when for a short period 10 per cent. of nickel was added to the new silver alloy in order to give the coins a whiter colour. In his comment upon the unfortunate experiment[1] the Deputy Master piquantly describes nickel as being a bad bedfellow with silver, and proceeds to recall a similar failure experienced by the Director of the Philadelphia Mint in 1869. The following is an excerpt from the American Mint Report for that year :—"We took pure silver and the purest nickel to be had. The fusion was very difficult and the melting had to be repeated several times, till finally it was evident that the two metals could not be forced into union, being even more repugnant to each other than gold and iron."

In 1875 the persistent Swiss, who have always shown great enterprise in token money experiments, made another alteration ; this time in respect of the base metal constituents of their 10 and 5 rappen coins, the silver content of these coins remaining unchanged. The new alloy was proportioned as follows :—

| Coin. | Copper, per cent. | Nickel, per cent. | Zinc, per cent. | Silver, per cent. |
|---|---|---|---|---|
| 10 rappen | 70 | 6 | 14 | 10 |
| 5 ,, | 70 | 7 | 18 | 5 |

The total quantity of coins issued from 1850 to 1877, composed of these three alloys, was about 60 millions.

(1) Royal Mint (London) Report for 1922, p. 10.

About the middle of the seventies a large proportion of the coins issued in 1850 and 1851 had grown so worn that it became desirable to withdraw them. Moreover, an exceptionally large number of cast counterfeit coins of these denominations had been passed into circulation. Examination of these counterfeits showed that the moulds for impressing the designs upon them had been made by placing a newly-minted genuine coin on a red-hot block of steel, an operation which was facilitated by the exceedingly hard nature of the original alloy. The counterfeit coins, though made of a soft alloy, are said in their fresh state to have been such close facsimiles of the genuine coins that they could only be detected by means of a chemical analysis to prove the presence of the silver content. Faced with this grave dilemma, the Swiss authorities determined to make another change in their token coinage alloy. They finally resolved to adopt for the 10 and 5 rappen coins the 75/25 per cent. copper nickel alloy which had meanwhile been successfully adopted by Belgium, the United States, and Germany. The weights laid down for the new coins under the Federal law of 29th March, 1879, were 3 grams and 2 grams respectively, and their diameters were those of the discarded coins.

It was not considered advisable to mint 20 rappen coins of the 75/25 per cent. copper nickel alloy on the ground that the disparity between the actual and nominal value of the coins would be excessive. The time had come, however, when the fallacy of this old monetary doctrine was to be exposed. During the debate which took place when the new coinage law was under discussion it was pointed out that its maintenance was no longer practicable, for the simple reason that if the nominal and actual values were to be approximated, either it would be necessary to give the coins made of copper nickel an inconveniently heavy weight, or an expensive metal must be incorporated in them. The unfortunate experience already gained as the result of mixing silver in the coin metal was sufficient to rule out the second alternative. But the tradition was so deeply engrained that the Swiss legislature was not yet

prepared to abandon it altogether in the case of the 20 rappen coins. So two years later they met the difficulty half way by adopting pure nickel for this denomination, the cost of nickel being then about double that of an equal volume of copper nickel. The pure metal was therefore originally adopted for coinage purposes solely on the ground of its intrinsic value.

The difficulties incidental to casting and rolling nickel in its pure state, and rendering it sufficiently soft and malleable for minting, had at that time been recently overcome by the well-known Austrian establishment, the Berndorf Metal Works ; and it was to this firm that the Swiss Federal Government committed their requirements for one million coin blanks in 1881. The blanks were struck at the Federal Mint in Berne, and the new coins were received by the public with acclamation. To this day coins of that and subsequent early issues. which escaped the melting pot during the war, are still in circulation in Switzerland, looking as bright and almost as fresh as the day they left the Mint. Saving a short interval during the war when nickel was not obtainable, there have been no alterations made in the specifications of the weights and compositions of these three Swiss token coins since 1881.

For the sake of clearness, the history of the Swiss nickel money has been related from 1850 to 1881 without a break. But, meanwhile, experiments in minting nickel alloy money had been made in the United States of America, in Belgium, and in Germany, as also by the Royal Mint in London on behalf of the colony of Jamaica.

* * * *

*United States of America, 1857.*

IN the United States a law was promulgated on 21st February, 1857, authorising the discontinuance of the issue of the cumbrous one-cent copper money which had

been in vogue there since 1796, money which was heavier even than our own current bronze penny pieces. The coins substituted for them were composed of 88 per cent. copper and 12 per cent. nickel, with a weight of 4·66 grams, which is rather less than that of our shilling. This proportion of nickel ingredient is not sufficient in quantity to change the colour of the copper from red to white, nor was it, indeed, added with that intention. The nickel was admittedly put into the coins with no other aim than that of approximating the intrinsic to the nominal value, thus showing that members of American Congress and Swiss legislators were dominated by the same fallacious notion. That all people in those days, however, were not obsessed by the prevailing tradition, is made evident by the remarks in the following extract taken from the Report of the Director of the Philadelphia Mint for 1863, whose conversion to the then new monetary creed was doubtless largely due to the example set by Belgium two years earlier when that country publicly jettisoned the old doctrine :—

" The coinage and issue of the nickel cent during the year has been very large—almost unprecedented. The demand still continues, and every effort has been made to supply it. This coin has been distributed to every part of the country, and orders for large amounts are daily received. The profits pay all expenses of the coinage and distribution of the cent.

" A great benefit to the country was effected by the Act of 1857, reducing the size of the cent. It is to be regretted that the idea still prevailed that it was necessary to put into the coin, if not an equivalent, at least a large proportion of real value. To this end, and for other reasons, an alloying metal was sought which should command a comparatively high price in the market, without being properly a precious metal. Nickel, possessing the requisite value and suitable qualities, was selected. It was then worth about two dollars per pound ; though it has since been lower in price.

Our cent was, by decreasing the size, reduced in weight from 168 to 72 grains; the former simply copper; the latter an alloy of 88 per cent. copper, with 12 per cent. nickel; making a coin of convenient size and neat appearance; and containing a half cent's worth of metal, more or less according to market fluctuations.

The change was well intended, but the experience of other countries, and indeed our own, has taught us that it was an unnecessary liberality; and that all the nickel we have thus used has been so much money wasted. In France they had formerly a copper "sou" or five centimes, about the same as our cent in legal value, weighing 154 grains troy; but the five centimes of the present day weighs only half as much. This latter is a mixture called bronze, and is composed of 95 per cent. copper, the remainder being tin and zinc, which adds nothing to the cost, but gives character and prestige to the coin. The mixture is less oxidable and more cleanly than copper. Now, this coin of half weight passes as readily and is, in fact, more acceptable to the public than the old heavy one. This is not surprising or unusual. Whilst people expect a full value in their gold and silver coins,(1) they merely want the inferior money for convenience in making exact payment, and not at all for the value of the copper, tin, or nickel which may be present. If the law makes it a cent, or legal tender to a proper and sufficient amount, then it is a cent to every one using it, even if its intrinsic should be only the one-tenth of its nominal and legal value.

"We have, therefore, used a great deal of nickel to little purpose; and much of it from foreign countries, for which we had to pay in gold or its equivalent. We have given it away, under the mistaken notion that value was essential to secure the circulation of our inferior coinage, and to prevent it being counterfeited. The law regulating the cent coinage required it, experience proves that an alloy more valuable than the principal metal may be safely omitted.

(1) *Prior to 1873 the monetary standard in the United States was silver. The silver coins referred to were, therefore, not token money, but standard money.*

" Nickel derives its name from a certain unpleasant allusion indicating its character, and which, in a metallurgic sense, it honestly deserves. It is very obstinate in the melting pot, requiring the fiercest fire even when in alloy with copper. It commonly makes a hard mixture, very destructive to dies, and all of the contiguous parts of the coining machinery. Perhaps as great an objection as any to the further use of this alloy is its limited use in the arts. With the addition of zinc it would make good German silver, and could be worked up into plated ware. Beyond this, and a few other applications, copper with 12 per cent. of nickel is of no more value to the artizan than copper alone ; it is even a deterioration, as it is more difficult to melt.

" On the whole, it may now be advised, and even urged, that the law of coinage be modified, so as to provide that the cent, retaining its present size and devices, shall be composed of 95 per cent. copper ; the remainder tin and zinc in suitable proportions.

" An effort is now making to re-establish in our country the manufacture of nickel from native ores.(1) If successful, as present appearances indicate it will be, the Mint may be supplied from this source, to the entire exclusion of the foreign article."

It is quite clear from the above remarks that the Director of the American Mint was under no illusion as to the obligation of using an expensive alloy for the cent coins, and his recommendations in this regard were adopted in the following year by Congress. But the last paragraph of the above-quoted extract leads one to suspect that his disparagement of nickel was provoked more by a nationalistic dislike of coining a metal the production of which was not native to his own country than by the difficulties the Mint experienced in employing it. For, although the copper nickel alloy of which he complained in 1863 is harder than plain copper, it is less hard than the 75/25 per cent. copper nickel alloy which was adopted in 1865

(1) *Refers probably to the Gap Mine nickel deposit at Lancaster, Pa., which was acquired and put into operation by a new owner in 1863, together with a refinery at Camden.*

by the United States for the 3 cent piece, and for the 5 cent piece in 1866.

Between 1857 and 1864 several issues of the one cent nickel alloy coins were made, comprising a total quantity of 200 million pieces. The price of nickel in 1857 stood at about 2 dollars a pound ; it appears to have risen in 1863 slightly above that high figure, but during the following two years the price per pound fell quickly to little more than one dollar.(1) The average annual production of nickel from 1861 to 1865 is estimated to have been about 300 tons, of which quantity 7 per cent. at least was absorbed for coinage in the United States, Switzerland, and Belgium.

Having realised the true nature of token money, the problems which had troubled the United States Congress, and the authorities at the Philadelphia Mint, became greatly simplified. The one cent nickel alloy coin with a weight of 4·66 grams was substituted by a bronze coin of 3·11 grams, and whereas the intrinsic value of the former coin was about one-half that of the nominal value, that of the bronze coin was about one-sixth, thus providing a wide margin for manufacturing costs and for profit to the Mint.

In 1865 a 3 cent coin of copper-nickel was authorised in the proportion of 75 per cent. copper to 25 per cent. nickel, the same alloy as Belgium had adopted four years earlier. The coin was inconveniently small, weighing 1·94 grams, a shade heavier than our threepenny bit. The appearance of this coin alloy, being nearly white in colour, gained popular approval, with the consequence that in 1866 a 5 cent coin of the same alloy, weighing 5 grams, was legalised. The making of the latter coin has been continued, with periodical alteration of the impressed design, to the present day ; no less than 1,300 millions of them having been minted during the period 1865 to 1924. The 3 cent coins were demonetised in 1890.

(1) *Washington Mint Report*, 1863. *Ontario Nickel Commission*, 1917, *p.* 325.

It is interesting to observe that the average annual demand for 5 cents pieces in the United States increased by about 150 per cent. after 1898, an increase which was probably due to the introduction of automatic " 5 cents in the slot " machines. In Great Britain a considerable rise in the public demand for pennies set in at the same time, doubtless owing to the same cause.

* * * *

*Belgium*, 1865.

About 1855 the Belgian administrative authorities decided to bring forward the question of reforming the low value currency of Belgium on the grounds that the silver 20 centimes piece was considered to be inconveniently small, while the 10 centimes copper money was too large and cumbrous. A further reason that rendered reform necessary was the fact that while Belgium was flooded with French copper money, her own stock of such money was constantly being depleted by its flight to Holland. This curious predicament was due to a complexity of causes which need not be detailed here.

A commission was accordingly appointed in 1856 to examine the economic and political sides of the question, together with a Sub-Commission to advise upon its technical aspects. The senior of these two bodies submitted its Report in 1859. The contents of this document are especially interesting for the reason that therein the validity of the theory hitherto held concerning the maintenance of a ratio between the intrinsic and nominal value of token money is formally contested for the first time. The Report begins by considering the question of the advisability of adopting the alloy chosen by Switzerland for her billon money in 1850, and proceeds forthwith to reject the necessity for following the Swiss example of adding silver to the alloy, an opinion which is supported by the following argument :—

" Experience proves that if the quantity of billon money in circulation is kept within proper limits, the

intrinsic value of the coins may be pitched much lower than their nominal value . . . . . If the silver content were withdrawn from the Swiss coins, there is no doubt that their purchasing power would remain unaltered, for it is merely to satisfy an old prejudice of the people that this metal is added to the alloy.

"In our case 'billon' money will not for the future be actual money; the coins will merely be vouchers or metal notes conferring the right to the possessors of obtaining something in exchange therefor. As far then as the intrinsic value of the coins is concerned, this is of no more importance than the intrinsic value of 100 and 1,000 francs paper notes."

The Commission then turn to the question of whether the inclusion of silver in the coin alloy imposes an obstacle to counterfeiture. It is pointed out by them that since the silver addition makes no difference in the appearance of the coins, the individual is not protected by its inclusion; and that the sole justification, in fact, for the inclusion of silver is that its absence in spurious coin may be detected by chemical analysis. But this is a slow process, and if counterfeiture were done on a large scale the expense incidental to detection by that means would be prohibitive. The best way of defeating the counterfeitor is the employment of a hard metal, and a sharply defined coin impression. Emphasis is also laid in the Report upon the fact that by putting silver into the coins the state foregoes its rightful profit on the manufacture and issue of low value currency.

Taking these and other circumstances into consideration, the Commissioners recommended the adoption of some form of the Swiss coinage alloy, "Argentan," minus the silver, the determination of the constituents of the alloy being left to the Sub-Commission.

The latter body submitted their Report in 1860. It is a full document containing matter of historic metallurgical interest, and as it marks an important departure

in the history of nickel alloy coinage, lengthy quotations therefrom may be given :—

" The Commission have not overlooked the merits of ' Argentan,' which is a white metal and easy to melt. They thought it wise, however, to avoid, as far as possible, the adoption of billon coins having a colour identical with that of silver,(1) and they furthermore deemed it desirable to select a metal of a kind difficult to work and so place an obstacle in the way of counterfeitors. They therefore had no hesitation in condemning the use of zinc in a proportion as great as that used in ' Argentan ' ; they even went further, and rejected the use of zinc altogether.

" The following are the reasons which have guided them to this conclusion :—The use of zinc entails the adoption of a ternary alloy. As a matter of principle they think it wise to avoid any ternary alloy, for the reason that the more simple the alloy, the easier the operations consequent upon future demonetization will be.

" Zinc is very volatile and is prone to oxidation ; consequently, it is difficult to obtain uniform castings from successive meltings even though these be carried out under precisely similar conditions, a difficulty which would be even more enhanced when the time came to remelt the perforated strips from which blanks had been already cut. This defect would necessarily give rise to a liability to variation in the colour of the metal cast at each melting operation. Moreover, it is to be borne in mind that whilst the separation of metals, particularly in the case of binary alloys, is generally easy to carry out, the separation of nickel from zinc is an exceptionally delicate operation.

" In order to put these theoretical considerations to test, your Commissioners ordered some experiments to be made, for which purpose the proportion of zinc used was to be limited to 3 per cent. The results fully

(1) *The colour of " Argentan " is very near that of silver owing to the inclusion of zinc in the alloy.*

confirmed their expectations. It has been found impossible to obtain castings of proportionately equal composition. There was no further ground for hesitation; the use of zinc was condemned. In support of our opinion we beg leave to quote the authority of Mr. Graham, Deputy Master of the London Mint, whose competence in such matters no one will question.

"Zinc being ruled out, we were limited, in accordance with the terms of our instructions, to giving our attention to simple alloys of copper and nickel . . . .

"We have tried in succession alloys having the following relative proportions :—

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Nickel | 18 | 20 | 21 | 23 | 25 | 27 | 30 | 35 | 40 | 45 | 50 |
| Copper | 82 | 80 | 79 | 77 | 75 | 73 | 70 | 65 | 60 | 55 | 50 |

"The first series of tests gave the following results :— Alloys containing nickel in proportions of 18, 20, 21, 23, 25, 27, 30 per cent. were obtained in a single melting. The two metals were perfectly united, but the presence of numerous blow-holes rendered the ingots unsuitable for rolling. The alloys containing 35, 40, 45, 50 per cent. of nickel had to be submitted to several successive melting operations; the ingots obtained were more vesicular than the former ones, and the metals were less perfectly united. The difficulties of melting were alone sufficient to induce the Commission to limit their ultimate experiments to the 18–30 per cent. nickel series of alloys.

"We therefore put in hand a second course of tests, the results of which were satisfactory. The ingots obtained were such that when submitted to the rolling operation the waste entailed was not abnormal. The sheets produced from these latter alloys were submitted to the various coining operations, which were all carried out successfully . . . .

"Of the various alloys tried by us, the 25 per cent. nickel type appears to be the most suitable; firstly,

because the ratio of 25 to 75 per cent., or 1 to 3, is a simple one, and will facilitate weighing and prevent errors; secondly, the difficulties encountered in the working of this type of alloy appear to be no greater than those we encountered in the other types tested by us."

The recommendations made by the two Commissions were accepted by the Government. The Belgians were therefore the first people to discover the merits of the 75/25 per cent. copper-nickel coinage alloy, an example which was followed four years later by the United States of America, and subsequently by a large part of the world.

On December 20th, 1860, a law was passed authorising the issue of the following types of coin :—

| Composition. | Denomination. | Weight. | Diameter. |
|---|---|---|---|
| Copper- | 20 centimes | 7·0 grams | 25 m/m. |
| Nickel 75/25 | 10 ,, | 4·5 ,, | 21 ,, |
| per cent. | 5 ,, | 3·0 ,, | 19 ,, |

This so-called "type de lion" was substituted in 1908 by perforated coins, known as the "type troué," an innovation which has also been very widely adopted elsewhere. The object secured thereby is that of ensuring that the holed coins may be readily distinguished by touch or by sight from solid coins having identical or similar diameters, a precaution that is unnecessary in countries where the antiquated custom of using large and cumbrous bronze money still persists.

Excepting the 20 centimes denomination, the provisions of the coinage law of 1908 are still in force. The 20 centimes coin was abolished in that year and a 25 centimes perforated coin substituted for it. The weights and diameters of the current "type troué" copper-nickel denominations are as follows :—

| Denomination. | Weight. | Diameter. |
|---|---|---|
| 25 centimes | 6·5 grams | 26 m/m. |
| 10 ,, | 4·0 ,, | 22 ,, |
| 5 ,, | 2·5 ,, | 19 ,, |

The effect of the war upon the subsidiary currencies of the continental countries of Europe, particularly those who were members of the Latin Monetary Union, is well known. Not only did silver money almost completely disappear from circulation, but nickel and nickel alloy money and even copper money suffered the same fate. Silver coins were either hoarded or had flowed to other Latin Union countries, such as Switzerland, where the exchange rates had not been seriously affected. Nickel and copper, on the other hand, being essential metals in armaments of war, stood at a high premium in countries which were cut off from oversea imports, and coinages composed of these metals were speedily drawn thither. In Belgium the former 2 and 1 fr. pieces of silver were substituted for the most part by paper notes, and denominations of 50 centimes and under consisted of zinc money minted during the German occupation.

Paper money representing low units of value is a costly form of currency. It soon becomes dirty and defaced by passing constantly from hand to hand, with the result that much time, trouble, and expense is incurred in collecting and cancelling old notes and printing new ones. In December, 1921, therefore, a Government Bill was presented to the Belgian Chamber of Representatives to authorise the minting of 60 million one franc metallic "jetons." A discussion then arose on the question of the choice of metal. The Minister of Finance proposed the adoption of aluminium bronze, an alloy which had recently been adopted by France for their 2 francs, 1 franc, and 50 centimes "jetons," but this proposal was rejected by the Chamber in favour of pure nickel. The reasons advanced for the preference of the latter metal were forcibly argued by one of the deputies, a portion of whose speech may be quoted :—(1)

> "In his statement setting forth the object of the Act, the Minister of Finance appeared to show a preference for aluminium bronze, though he did not give a definite pronouncement regarding the choice of metal. Fortunately, the metal is not specified in the draft of the

(1) *Belgian Mint Report for* 1921, *p.* 51, *et seq.*

Bill, and I would request the Minister to retain complete liberty of action on that question.

" In issuing this money, money which one might term famine money, France has indulged in the luxury of making it out of aluminium bronze, a good metal having the appearance of gold, the employment of which is more expensive than nickel. This choice of France was based upon the highly laudable desire to prevent counterfeiture, for the minting of aluminium bronze is extremely difficult.

" But experience has clearly shown that the sacrifice made to this end is likely to precipitate an actual loss. Forgers have overcome the difficulty; they have discovered a wonderful substitute.

" They leave aluminium bronze alone, which defies their artifices, and substitute brass for it, consisting of two parts of tin to one of copper. This alloy, which is easy to work, provides a yellow metal of good appearance, and is so like aluminium bronze as to be easily mistaken for it. Ever since the issue of these metallic tokens took place, counterfeit tokens made of brass have appeared, which bear such close resemblance to genuine coins that they require the eyes of an expert to detect them. The public cannot fail to be taken in by them; herein lies the danger.

" Compared with gold coins, which preserve their lustre, those made of aluminium bronze quickly lose their semblance of pinchbeck jewellery; their appearance soon becomes changed in circulation, and they then assume the look of used brass coins.

" But is it possible in practice to prevent this confusion and counterfeiting? It can be easily done. We have two easy means of dealing with it. The first one is the employment of nickel.

" Nickel is of all coinage metals the one which offers the greatest obstacle to counterfeiture. In this regard

it has the advantage even over gold and silver because of its higher melting point; gold and silver melt at a temperature of about 1,000° C., whereas to cast nickel a temperature of 1,400° C.(1) is required. Moreover, during the twenty years or so that statistics of bogus money have been kept, the discovery of forged nickel coins has been extremely rare. And, lest it should be said that billon money represents a value so small as not to invite counterfeiture, it is enough to mention that during the period of occupation, when nickel was substituted by zinc, forged 25 centimes coins were abundant."

The Bill became law on December 31st, 1921, and authority was given under it to issue 73 million one franc "jetons-bons" in pure nickel. Further legislation was passed in the same year, and again in 1923, for the issue respectively of 50 centimes and 2 francs "jetons-bons" in the same metal. The weights and diameters of the three coins are as follows :—

| Denomination. | Weight. | Diameter. |
|---|---|---|
| 2 francs | 10·0 grams | 27 m/m. |
| 1 franc | 5·0 ,, | 23 ,, |
| 50 centimes | 2·5 ,, | 18 ,, |

The total weight of metal used for these three types of Belgian coins up to the end of 1924 was a little over 400 tons.

In the Belgian Congo State 75/25 per cent. copper-nickel money was introduced in 1906 for 20, 10 and 5 centimes pieces, and after the war 1 franc and 50 centimes pieces in the same alloy were also authorised.

* * * * *

JAMAICA adopted nickel alloy coins by authority of an Order in Council made in 1869, approving the issue of one *Jamaica, 1869.*

(1) *The melting point of pure nickel appears to have been slightly understated by the speaker.*

penny and half-penny pieces composed of 80 per cent copper and 20 per cent. nickel. These two coins have the same weights and diameters as those of the British penny and half-penny. On the obverse they carry the head of the reigning British sovereign, and on the reverse the arms of Jamaica consisting of five pineapples on a shield, surmounted by " a cayman or alligator proper."

The introduction of nickel alloy coins in Jamaica was due to popular dislike of British copper money. It appears that the inhabitants of the island, 98 per cent. of whom are of African descent, had grown accustomed to the use of low denominations of British, Spanish, Mexican, and Colombian silver money ranging from a coin representing a value of 4d. down to one of 1½d. In 1863 the financial status of the island had fallen into a very bad condition as the result of disorganisation following the abolition of slavery. The emancipated slaves refused to work, with the result not only that the plantations were falling into decay, but the people were losing in wages to the extent of some £250,000 a year. In order to rouse them from this lethargy and to impress upon them a sense of their civil obligations, a new system of taxation was imposed. At the same time all the silver fractional denominations of foreign dollars which were current in the island were proclaimed to be no longer legal tender. The dissatisfaction caused by these measures, coupled with other circumstances, culminated in a serious outbreak of civil disorder in 1865, which led in turn to a change in the system of administration. But, notwithstanding the efforts made under the new regime to bring about a better understanding, the prejudice of the negroes against copper money remained steadfast. The newly-formed legislature, therefore, with a view to humouring the illiterate working classes, met the difficulty half-way by authorising the substitution of nickel for one-fifth of the copper contents of pennies and half pennies, which gave a silvery appearance to the coins. This 80/20 per cent. copper-nickel alloy was maintained until 1906, when it was changed to 75 per cent. copper and 25 per cent. nickel. A farthing

coin was introduced in 1880 composed of the same alloy. These coins are still maintained in Jamaica to the exclusion of British bronze money, which was demonetized in 1882.

* * * *

*Germany*, 1873

THE whole coinage of the German Empire underwent a complete remodelling when Germany adopted the decimal system shortly after the Franco-Prussian War of 1870-71. It was in these circumstances that the Government in 1873 introduced the 75/25 per cent. type of copper-nickel alloy for 10 and 5 pfennig pieces, coins which were followed some years later (1886) by the issue of a 20 pfennig piece made of the same alloy to replace the silver coin which had hitherto represented that denomination. Neither the one nor the other of these 20 pfennig coins had been popular in Germany, and in 1902 a law was passed authorising the gradual withdrawal of the copper-nickel piece. Its withdrawal affords a good instance of the axiom that a coin which fails to conform to the wants and prejudices of the users cannot for long be maintained in circulation. The people had become accustomed, under the currency systems which obtained in the German states before federation, to quarter and eighth parts of the thaler and the florin, and they could not be induced to accept a coin which entailed reckoning in multiples of fifths, so the abolition of the 20 pfennig piece was hailed with delight. But when, as the result of gradual withdrawals, the coin became scarce, public clamour for a denomination to fill up the gap between the 10 pfennig piece and the half-mark became loud and insistent, and the selection of a new value was keenly canvassed throughout the country. A proposal that a 30 pfennig piece should be adopted was promptly negatived on the ground that its effect would be to raise to that figure the cost of many articles and services which stood at 25 pfennigs; while the Banks and the Revenue Offices objected to

a 25 pfennig coin on the ground of the inconvenience which it would cause to accountants, and they were supported in their opposition by those influential bodies who discountenanced any departure from a pure decimal system. The general public, on the other hand, were strongly in favour of a 25 pfennig piece for the reason that in small daily business transactions it is much more natural to reckon by halves and quarters than by fifths. " If it be considered necessary," they said, " to divide the mark into two equal parts, is it not logical also to divide the half-mark in the same manner ? " And meeting the decimal purists on their own ground, they maintained that a 25 pfennig piece would conform to the decimal system fully as well as the " metre " does, the length of which is based on the measurement of one quarter of the ten-millionth part of the equator.

Confronted by a preponderating volume of popular opinion in favour of quartering the mark, the Government authorised in 1908 the issue of a 25 pfennig piece, and this was made of pure nickel. The weight and diameters of the four coins were as follows :—

| Denomination. | Weight. | Diameter. | Composition. |
|---|---|---|---|
| 10 pfennig | 4·0 grams | 21 m/m. | 75/25 % C/N. |
| 5 ,, | 2·5 ,, | 18 ,, | 75/25 ,, |
| 20 ,, | 6·5 ,, | 23 ,, | 75/25 ,, |
| 25 ,, | 4·0 ,, | 23 ,, | Pure nickel |

It will be observed that the weight of the 25 pfennig piece was the same as that of the 10 pfennig piece, while its diameter is 2 m/m. greater. The increase of diameter has been obtained by reducing the thickness of the coin, which is only 1·1 m/m. Notwithstanding its thinness, the blank takes a clear, sharp-cut impression in sufficiently high relief, thus showing that pure nickel flows readily under the striking blow, provided the coin blanks have been properly annealed. The coin, in fact, ranks high in technical and artistic excellence among the nickel coins of the world. From this observation it may be gathered that there is no need to maintain a rigid ratio between the

weight and diameter of a pure nickel coin, and a considerable saving can therefore be made in the weight of metal employed. The diameters, for instance, of the 20 and 25 pfennig pieces are identical, whereas there is a difference in weight of 2·5 grams between the two coins, which is equal to a saving of 2½ metric tons per million coins.

The effect of the great war upon German coinage was disastrous. All coins containing nickel or copper soon followed pots and pans made of those metals, as well as bronze door-knockers and bells, into the melting pot to be turned into munitions of war. Various other base metals were therefore employed for low value token money, such as iron, zinc, or aluminium. In 1923, when reorganisation of the finances of the country had been taken in hand, aluminium bronze was adopted for coins ranging in value from 50 pfennig to 5 pfennig. But this alloy having been found in practice to be an unsatisfactory coinage medium, Germany is said to be contemplating a return to her nickel coinage of pre-war days.

* * * *

*Austria-Hungary*, 1892.

THE introduction of nickel money into Austria-Hungary took place when the monetary system of that country was reformed in 1892. Guided by the favourable experience of Switzerland in pure nickel currency, (no other country at that time having adopted this form of money), the ruling authorities of the dual Monarchy wisely determined to follow the Swiss example, and pure nickel was accordingly adopted for 10 and 20 heller pieces, lower denominations being made of bronze. The manufacture of the coin blanks was entrusted to the Austrian house of Berndorf, who had previously furnished the Swiss blanks, and between 1892 and 1914 more than 500 million of these pure nickel coins were struck at the Austrian and Hungarian Mints, representing a weight of upwards of

1,100 metric tons of metal. The weights and diameters of the two coins were as follows :—

| Denomination. | Weight. | Diameter. |
|---|---|---|
| 20 heller | 4 grams. | 21 m/m. |
| 10 „ | 3 „ | 19 „ |

* * * *

*Italy*, 1893. In 1894 Italy introduced a copper-nickel 20 centesimi coin which was demonetized in 1910. Meanwhile, in 1902, a pure nickel piece representing a value of 25 centesimi had been put in circulation. For eight years, therefore, the 20 and 25 centesimi coins were current at the same time. It was decided in 1908 to withdraw the 25 centesimi denomination and substitute for it a 20 centesimi coin of the same weight, size, and composition. During the war period, this pure nickel money disappeared from circulation, and the Italian Government in 1918 authorised the issue of 20 centesimi coins of copper-nickel, the blanks for which were made in the United States of America. After the war Italy reverted to the pure nickel type of 20 centesimi coin originally introduced in 1908. The development of pure nickel coinage has been carried further by Italy than by any other state. In 1920 a 50 centesimi piece was coined, and this was followed in 1921 by a one lira piece and in 1922 by a two lire piece, all of pure nickel. The experiment of putting into circulation pure nickel money representing values as high as two and one lire has proved a complete success, and clearly demonstrates that the issue and circulation of silver token coins is a needless expenditure, provided that the substituted metal is of a kind to defeat successful counterfeiture. The weight of nickel money in circulation in Italy at the end of 1924 was about 2,500 metric tons. Had this money been made of silver, having the weights and fineness prescribed by the Latin Monetary Union, of which Italy is a member, the cost of the metal would have

been about twenty times greater. The Italian pure nickel coins now current are as follows :—

| Denomination. | Weight. | Diameter. |
|---|---|---|
| 2 lire | 10 grams | 29·0 m/m. |
| 1 lira | 8 „ | 26·5 „ |
| 50 centesimi | 6 „ | 24·0 „ |
| 20 „ | 4 „ | 21·5 „ |

The medallic art of modern Italy has evoked much admiration. The designs distinctive of each coin present to the eye a pleasing combination of the uncramped art of the Renaissance with the perfection of technique which modern mechanical appliances ensure.

* * * *

*France, 1893.*

SAVING Spain and Russia, France was the last great European continental power to reform her low value token currency. It was taken in hand there piecemeal. From 1883 onwards the question of the desirability of abolishing the cumbrous dirty sous, as well as the inconveniently small 20 centimes silver coins, had been brought to the attention of the Ministry of Finance with monotonous repetition. Commission after Commission was appointed to advise on the matter, and report after report was submitted and shelved. At length in 1893 legislative authority was obtained to coin a 25 centime piece in pure nickel in place of the 20 centimes silver money. This was sanctioned by way of a tentative measure, and if it proved successful, 10 and 5 centimes were to be made of the same metal; but unfortunately the first type of the new coin issued failed to obtain popular approval. Apart from the fact that the diameter chosen for it differed by only half a millimetre from that of the one franc silver piece—a similarity which naturally caused a good deal of vexatious confusion—the design of the reverse was bald and inartistic. Authority was therefore obtained in the following year to replace the coin by a new type of the

same diameter, but made distinguishable from the franc piece by having a facetted rim. This alteration, however, again failed to satisfy the public, for the reason that the facets, being 22 in number, were not sufficiently perceptible to the touch. It was pointed out by the Mint Authorities in Paris that to accentuate the angles by reducing the number of facets was practically impossible, and the Government eventually fell back in 1912 upon the idea, which had already been reluctantly advocated, of minting perforated coins, a type which is much to be recommended on practical grounds, but which a large section of the French public disapproved of for æsthetic reasons. Owing to their unpopularity the minting of the facetted coins was discontinued after 1905, and only 24 millions of them were put into circulation. The postponement of giving legislative authority for the perforated 25 centimes denomination until 1912 was apparently due to two causes. For one thing it was felt that the change, when made, should include the abolition of the sou and the half-sou bronze money. Secondly, there were strong influences brought to bear in 1908 to induce the Government to substitute aluminium for the bronze currency, and when that proposition was overruled, to adopt an aluminium-bronze alloy, known as the Sainte-Claire-Deville alloy, composed of 90 per cent. copper and 10 per cent. aluminium. Much time and money were spent in experiments designed to render this alloy suitable for coinage purposes, but without avail. Blanks made therefrom were so hard that the coinage dies broke under the impact of the striking blow. The experiments were even carried to the length of trying whether it was practicable to overcome the difficulties due to the hardness of the metal by heating the blanks to soften them and striking them in the hot state. This method having been proved to be impracticable, it was sought to minimise the hardness of the alloy by reducing the aluminium content to 9 per cent., but the results were again disappointing; and when the aluminium percentage was further reduced, the metal forfeited its character of durability.

It was not until 1911 that the trials were abandoned as hopeless. The Minister of Finance then informed the Chamber that aluminium and aluminium-bronze having been discarded as unsuitable, nickel was the only metal which fulfilled the conditions required of "billon" money. A Bill to sanction the issue of 25, 10, and 5 centimes pieces in pure nickel was accordingly laid before the Chamber of Representatives in 1913. The Bill became law in August of that year, and the following denominations in perforated type were authorised :—

| Denomination. | Weight. | Diameter. |
|---|---|---|
| 25 centimes | 5 grams | 24 m/m. |
| 10 ,, | 4 ,, | 21 ,, |
| 5 ,, | 3 ,, | 19 ,, |

If this coinage reform had been entirely carried out, the weight of nickel required would have aggregated some 2,500 tons ; but no sooner had the French Mint made necessary preparations for coping with the large undertaking than the war broke out.

The essential need which now arose for economising the use of nickel so that it might be devoted to armament purposes rendered it undesirable to proceed with the new coinage, with the consequence that only 1½ millions of the 25 and 10 centimes denominations, and none of the 5 centimes denominations, were issued up to 1917. In that year an amending law was passed which provided that the coins should be made of 75/25 per cent. copper-nickel, their weights and dimensions remaining as before, and this law is still in force. The total weight of these nickel alloy coins put into circulation between 1917 and 1924 was 722 metric tons.

* * * *

*Dominions and Colonies.*

THOUGH Great Britain has so far not seen fit to adopt nickel or copper-nickel coins, the overseas parts of the Empire have for the most part done so, the outstanding

exceptions being Australia, South Africa, and New Zealand, whose coinages are identical with, or closely follow the types appertaining to, the mother country. The most important of the Empire overseas "nickel" coinages, in point of weight of the currency in circulation, is that of British India, where 4 annas, 2 annas and 1 anna copper-nickel coins circulate in very large quantities. The 1 anna piece was introduced in 1908, and the 2 and 4 anna pieces ten years later. An 8 anna copper-nickel coin was brought into circulation at the same time, but not many of them were struck for the reason, it is understood, that the coin was largely counterfeited.(1) The three lower denominations of the Indian copper-nickel coins bear peculiar shapes, the 4 and 1 anna pieces having corrugated edges and the 2 anna piece being square with rounded corners. The total quantity minted and issued from 1908 to 1924 was upwards of 900 millions of coins. The weights and diameters of the denominations are as follows :—

*British India*, 1908.

| Denomination. | Weight. | Diameter. |
|---|---|---|
| 8 annas | 7·776 grams | 26·0 m/m. |
| 4 ,, | 6·804 ,, | 24·0 ,, |
| 2 ,, | 5·832 ,, | 21·5 ,, |
| 1 ,, | 3·888 ,, | 20·5 ,, |

*Canada*, 1921. Canada substituted pure nickel for silver in 1921 for her 5 cent piece. The change from one metal to the other is being introduced gradually, and both types of the denomination are therefore in present circulation. Up to the end of 1924, about 10 million of the nickel coins had been issued. The coins are minted in the Royal Mint at Ottawa. It is of interest to note that fewer coinage dies are required for striking the Canadian pure nickel 5 cent pieces than were needed for the old silver 5 cents pieces, notwithstanding the fact that nickel is considerably harder than silver. Thus at the first minting in 1922, one pair of dies (obverse and reverse) was found to be sufficient for striking 100,000 blanks, whereas the average life of a pair of dies for the silver 5 cents coins was only sufficient to give 18,000 good coins. The explanation of this is

(1) *It is to be borne in mind that the facilities for passing spurious coin into circulation in a country where a large proportion of the population is in a backward condition are much greater than in a more forward country.*

that the silver coin blank was not thick enough to " cushion " properly between the dies ; in other words, the blank was too thin to enable the metal to flow freely on impact. The weight and diameter of the Canadian 5 cent pure nickel coin are 4·536 grams and 21·08 millimetres respectively, while those of the silver coin are 1·166 grams and 15·6 millimetres.

* * * *

*Conclusion.*

WE have now reached the stage in the history of nickel money when the advantages obtainable by its adoption had obtained almost universal acceptance. A few words given to a consideration of the broad principles on which the preference for this type of money is based will therefore not be out of place.

It is fairly safe to assume that but for the late war the more important countries on the Continent of Europe would by now have adopted pure nickel for all token coins of nominal values ranging between approximate equivalents of one penny to threepence or even to sixpence, for coinage authorities were then, as now, almost unanimously in agreement that no other base metal equally well fulfils the several requirements of a token currency. These requirements may be summarized under five headings : (1) Durability ; (2) Lowness of price ; (3) Sightliness ; (4) Security against counterfeiture ; (5) Cleanliness. Pure nickel is the only metal which fully satisfies all these requirements.

The cost of pure nickel is rather higher than copper-nickel alloy, but its superior wearing qualities much more than justify the initial difference in price. Its permanent character was indicated by an experiment conducted by the Swiss Mint. When during the latter stages of the war token coinage metals became scarce in Switzerland, the Mint in Berne was driven to make billon money of brass. And lest brass also should become no longer available, the

Mint authorities struck some coins composed of a light aluminium alloy with a view to making a comparative test of the wearing qualities of this material. In order to make the test complete, equal quantities of various Swiss coins were mixed together inside a revolving drum, which was thereupon kept in motion for 40 hours. The following abrasion results were thereby manifested :—

| | | | | |
|---|---|---|---|---|
| 2 | franc piece, | 835 silver, 165 copper | 6·62 | per mille. |
| 1 | ,, | ,, ,, ,, | 7·79 | ,, |
| ½ | ,, | ,, ,, ,, | 5·77 | ,, |
| 20 | rappen piece | of pure nickel . | 0·59 | ,, |
| 10 | ,, ,, | copper-nickel . | 2·45 | ,, |
| 10 | ,, ,, | brass (ca. 60 copper, 40 zinc) | 3·69 | ,, |
| 10 | ,, ,, | aluminium alloy. | 11·27 | ,, |
| 5 | ,, ,, | copper-nickel . | 3·29 | ,, |
| 5 | ,, ,, | brass . . | 4·01 | ,, |
| 2 | ,, ,, | bronze . . | 1·09 | ,, |
| 1 | ,, ,, | ,, . . | 1·23 | ,, |

The result of this interesting experiment went to show that the resistance to abrasion of pure nickel coins compared to that of those made of 75/25 per cent. copper-nickel alloy is as 5 to 1. On this showing, therefore, a clear saving in the long run is achievable by issuing coins of pure nickel, even if the initial cost were four times as much as that of the copper-nickel alloy, while, as a matter of fact, it is only about 60 per cent. greater.

A yet more important recommendation than durability is the fact that pure nickel coins are proof against successful counterfeiture. The technical difficulties of melting and preparing the metal for coinage, added to the fact that heavy and expensive machinery must be employed for the purpose, combine to impose insuperable obstacles to unauthorised coiners ; and an additional safeguard lies in the fact that pure nickel is the only coinage metal which is highly sensitive to magnetic attraction.

To make this brief history complete without recourse to unnecessary and tiresome repetition, four tables are given

of past and present nickel and nickel alloy coinages in Europe, Asia, Africa, and America, followed by a Chart showing the relative metric tonnages of such coins struck from 1910 to 1924. It may be seen from this chart to what extent the demand for nickel, so essential in the manufacture of munitions, was deflected from coinage use during the war period. The sharp rise in consumption of copper-nickel for coinage which occurred during the war years 1916 to 1918 was chiefly due to the demand for small change in the United States and in the Indian Empire, regions which were both outside the actual theatre of war.

# *NICKEL and COPPER-NICKEL COINAGES of the WORLD*

## EUROPE

| Country. | Date of Introduction. | Composition. | Type. | Denomination. | Weight. Grams. | Diameter. m/m. |
|---|---|---|---|---|---|---|
| Albania | 1926 | Nickel | Solid | 1 lek | 8·00 | 27·0 |
| ,, | ,, | ,, | ,, | ½ ,, | 6·00 | 24·0 |
| Austria Hungary | 1892 | ,, | ,, | 20 heller | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 3·00 | 19·0 |
| Austria | 1923 | Cu.75% Ni.25% | ,, | 10 groschen | 4·50 | 22·0 |
| Belgium | 1860 | ,, | ,, | 20 centime | 7·00 | 25·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 4·50 | 21·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 3·00 | 19·0 |
| ,, | 1908 | ,, | Holed | 25 ,, | 6·50 | 26·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 4·00 | 22·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·50 | 19·0 |
| ,, | 1921 | Nickel | Solid | 50 ,, | 2·50 | 18·0 |
| ,, | ,, | ,, | ,, | 1 franc | 5·00 | 23·0 |
| ,, | ,, | ,, | ,, | 2 ,, | 10·00 | 27·0 |
| Bulgaria | 1888 | Cu.75% Ni.25% | ,, | 20 stotinki | 5·00 | 21·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 4·00 | 19·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 3·00 | 17·0 |
| ,, | 1924 | ,, | ,, | 2 leva | 5·00 | 23·0 |
| ,, | ,, | ,, | ,, | 1 lev | 3·00 | 20·0 |
| Crete | 1900 | ,, | ,, | 20 lepta | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 3·00 | 19·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·00 | 17·0 |
| Czecho-Slovakia | 1921 | Cu.80% Ni.20% | ,, | 1 krone | 6·66 | 25·0 |
| ,, | ,, | ,, | ,, | 50 heller | 5·00 | 22·0 |
| ,, | ,, | ,, | ,, | 20 ,, | 3·33 | 20·0 |
| ,, | 1924 | Cu.75% Ni.25% | ,, | 5 krone | 10·00 | 30·0 |
| Danzig | 1923 | ,, | ,, | 10 pfennig | 4·00 | 22·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·00 | 18·0 |
| Denmark | 1920 | ,, | ,, | 50 öre | 4·80 | 22·0 |
| ,, | ,, | ,, | ,, | 25 ,, | 2·40 | 17·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 1·50 | 15·0 |
| Esthonia | 1922 | ,, | ,, | 5 mark | 4·50 | 23·0 |
| ,, | ,, | ,, | ,, | 3 ,, | 3·00 | 20·0 |
| ,, | ,, | ,, | ,, | 1 ,, | 2·50 | 18·0 |
| Finland | 1921 | ,, | ,, | 2 mark | 10·367 | 27·5 |
| ,, | ,, | ,, | ,, | 1 ,, | 5·183 | 24·0 |
| ,, | ,, | ,, | ,, | 50 pennia | 2·550 | 18·5 |
| ,, | ,, | ,, | ,, | 25 ,, | 1·275 | 16·0 |

| Country. | Date of Introduction. | Composition. | Type. | Denomination. | Weight. Grams. | Diameter. m/m. |
|---|---|---|---|---|---|---|
| France | 1893 | Nickel | Solid | 25 centime | 7·00 | 24·0 |
| ,, | 1894 | ,, | Facetted | 25 ,, | 7·00 | 24·0 |
| ,, | 1914 | ,, | Holed | 25 ,, | 5·00 | 24·0 |
| ,, | 1913 | ,, | ,, | 10 ,, | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 3·00 | 19·0 |
| ,, | 1917 | Cu.75% Ni.25% | ,, | 25 ,, | 5·00 | 24·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 3·00 | 19·0 |
| Germany | 1873 | ,, | Solid | 10 pfennig | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·50 | 18·0 |
| ,, | 1886 | ,, | ,, | 20 ,, | 6·25 | 23·0 |
| ,, | 1908 | Nickel | ,, | 25 ,, | 4·00 | 23·0 |
| Greece | 1893 | Cu.75% Ni.25% | ,, | 20 lepta | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 3·00 | 19·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·00 | 17·0 |
| ,, | 1912 | Nickel | Holed | 20 ,, | 5·00 | 23·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 3·00 | 19·0 |
| Italy | 1894 | Cu.75% Ni.25% | Soffa | 20 centesimi | 4·00 | 21·5 |
| ,, | 1902 | Nickel | ,, | 25 ,, | ,, | ,, |
| ,, | 1908 | ,, | ,, | 20 ,, | ,, | ,, |
| ,, | 1918 | Cu.75% Ni.25% | ,, | 20 ,, | ,, | ,, |
| ,, | 1921 | Nickel | ,, | 50 ,, | 6·00 | 24·0 |
| ,, | ,, | ,, | ,, | 1 lira | 8·00 | 26·5 |
| ,, | ,, | ,, | ,, | 2 lire | 10·00 | 29·0 |
| Jugo Slavia | 1921 | Cu.75% Ni.25% | ,, | 25 para | 5·70 | 24·0 |
| ,, | 1925 | ,, | ,, | 50 ,, | 25·0 | 18·0 |
| ,, | ,, | ,, | ,, | 1 dinar | 5·00 | 23·0 |
| ,, | ,, | ,, | ,, | 2 ,, | 10·00 | 27·0 |
| Latvia | 1922 | Nickel | ,, | 50 santimu | 6·50 | 25·0 |
| ,, | ,, | ,, | ,, | 20 ,, | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 3·00 | 19·0 |
| Luxemburg | 1901 | Cu.75% Ni.25% | ,, | 10 centime | 3·00 | 20·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·00 | 17·0 |
| ,, | 1908 | ,, | ,, | 5 ,, | 2·50 | 18·0 |
| ,, | 1924 | ,, | ,, | 10 ,, | 4·00 | 22·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·50 | 19·0 |
| ,, | ,, | Nickel | ,, | 2 franc | 10·00 | 27·0 |
| ,, | ,, | ,, | ,, | 1 ,, | 5·00 | 23·0 |
| Montenegro | 1906 | ,, | ,, | 20 para | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 3·00 | 19·0 |
| Netherlands | 1906 | Cu.75% Ni.25% | ,, | 5 cent | 4·50 | 18·0 |
| ,, | 1912 | ,, | Square | 5 ,, | 4·50 | 18·0 |

| Country. | Date of Introduction. | Composition. | Type. | Denomination. | Weight. Grams. | Diameter. m/m. |
|---|---|---|---|---|---|---|
| Norway | 1920 | Cu.75% Ni.25% | Solid | 50 öre | 4·80 | 22·0 |
| ,, | ,, | ,, | ,, | 25 ,, | 2·40 | 17·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 1·50 | 15·0 |
| Poland | 1924 | Nickel | ,, | 50 groszy | 5·00 | 23·0 |
| ,, | ,, | ,, | ,, | 20 ,, | 3·00 | 20·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 2·00 | 17·6 |
| Portugal | 1900 | Cu.80% Ni.20% | ,, | 100 reis | 4·00 | 22·0 |
| ,, | ,, | ,, | ,, | 50 ,, | 2·50 | 18·0 |
| ,, | 1917 | ,, | ,, | 4 centavos | 5·00 | 23·0 |
| ,, | 1920 | ,, | ,, | 20 ,, | 6·00 | 23·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 3·00 | 19·0 |
| Roumania | 1900 | Cu.75% Ni.25% | ,, | 20 bani | 7·00 | 25·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 4·50 | 22·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 3·00 | 19·0 |
| ,, | 1905 | ,, | Holed | 20 ,, | 6·00 | 25·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 4·00 | 22·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·50 | 19·0 |
| ,, | 1924 | ,, | Solid | 2 lei | 7·00 | 25·0 |
| ,, | ,, | ,, | ,, | 1 leu | 3·50 | 21·0 |
| Serbia | 1883 | ,, | ,, | 20 para | 6·00 | 22·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 4·00 | 20·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 3·00 | 17·0 |
| ,, | 1906 | Nickel | ,, | 20 ,, | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 3·00 | 19·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·00 | 17·0 |
| ,, | 1917 | Cu.75% Ni.25% | ,, | 20 ,, | — | — |
| ,, | ,, | ,, | ,, | 10 ,, | — | — |
| ,, | ,, | ,, | ,, | 5 ,, | — | — |
| Sweden | 1920 | ,, | ,, | 50 öre | 4·80 | 22·0 |
| ,, | ,, | ,, | ,, | 25 ,, | 2·40 | 17·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 1·50 | 15·0 |
| Switzerland | 1850 | Cu.Ni.Zn.Ag. | ,, | 20 rappen | 3·25 | 21·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 2·50 | 19·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 1·66 | 17·0 |
| ,, | 1879 | Cu.75% Ni.25% | ,, | 10 ,, | 3·00 | 19·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·00 | 17·0 |
| ,, | 1881 | Nickel | ,, | 20 ,, | 4·00 | 21·0 |
| Turkey | 1911 | ,, | ,, | 40 para | 6·00 | 23·5 |
| ,, | ,, | ,, | ,, | 20 ,, | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 2·65 | 18·5 |
| ,, | ,, | ,, | ,, | 5 ,, | 1·75 | 16·0 |
| ,, | 1918 | Cu.75% Ni.25% | ,, | 40 ,, | 6·00 | 23·5 |
| ,, | ,, | ,, | ,, | 10 ,, | 2·65 | 18·5 |

## ASIA

| Country. | Date of Introduction. | Composition. | Type. | Denomination. | Weight. Grams. | Diameter. m/m. |
|---|---|---|---|---|---|---|
| British India | 1908 | Cu.75% Ni.25% | Corrugated | 1 anna | 3·888 | 20·5 |
| ,, | 1918 | ,, | Square | 2 annas | 5·832 | 21·5 |
| ,, | ,, | ,, | Corrugated | 4 ,, | 6·804 | 24·0 |
| ,, | ,, | ,, | Round | 8 ,, | 7·776 | 26·0 |
| British North Borneo | 1903 | Cu.75% Ni.25% | Solid | 5 cents | 7·290 | 28·0 |
| ,, | ,, | ,, | ,, | 2½ ,, | 4·860 | 25·0 |
| ,, | ,, | ,, | ,, | 1 ,, | 3·240 | 20·0 |
| Ceylon | 1909 | ,, | Square | 5 ,, | 3·887 | 18·0 |
| Dutch East Indies | 1913 | ,, | Solid | 5 ,, | 5·00 | 21·0 |
| French Indo-China | 1923 | ,, | Holed | $\frac{1}{20}$ piastre | 5·00 | 24·0 |
| French Syria | 1922 | ,, | Solid | ½ ,, | 4·00 | 21·0 |
| Hedjaz | 1926 | ,, | ,, | 1 ,, | 6·48 | 26·0 |
| ,, | ,, | ,, | ,, | ½ ,, | 5·18 | 23·0 |
| ,, | ,, | ,, | ,, | ¼ ,, | 4·21 | 20·0 |
| Japan | 1889 | ,, | ,, | 5 sen | 4·67 | 20·75 |
| ,, | 1920 | ,, | ,, | 10 ,, | 3·75 | 22·12 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·63 | 19·09 |
| Kiao Chau | 1909 | ,, | ,, | 10 cents | 4·00 | 21·50 |
| ,, | ,, | ,, | ,, | 5 ,, | 3·00 | 18·50 |
| Korea | 1902 | ,, | ,, | 5 chon | 4·67 | 20·75 |
| Persia | ,, | ,, | ,, | 2 shahi | 4·50 | 21·0 |
| ,, | ,, | ,, | ,, | 1 ,, | 3·00 | 19·0 |
| Philippine Is. | 1903 | ,, | ,, | 5 cents | 5·00 | 21·5 |
| Sarawak | 1920 | ,, | ,, | 10 ,, | 5·830 | 26·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 3·887 | 21·0 |
| ,, | ,, | ,, | ,, | 1 ,, | 1·944 | 18·0 |
| Siam | 1909 | Nickel | Holed | 10 satang | 3·50 | 20·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·00 | 17·5 |
| Straits Settlements | 1920 | ,, | Solid | 5 cents | 4·000 | 20·0 |

## AFRICA

| | | | | | | |
|---|---|---|---|---|---|---|
| Angola | 1921 | Nickel | Solid | 50 centavos | 10·50 | 31·0 |
| ,, | ,, | Cu.75% Ni.25% | ,, | 20 ,, | 6·00 | 23·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 3·00 | 19·0 |

| Country. | Date of Introduction. | Composition. | Type. | Denomination. | Weight. Grams. | Diameter. m/m. |
|---|---|---|---|---|---|---|
| Belgian Congo | 1906 | Cu.75% Ni.25% | Holed | 20 centimes | 6·00 | 25·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 4·00 | 22·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·50 | 19·0 |
| ,, | 1920 | ,, | Solid | 1 franc | 10·00 | 29·0 |
| ,, | ,, | ,, | ,, | 50 centimes | 6·50 | 24·0 |
| British E. Africa | 1906 | ,, | Holed | 10 cents | 11·340 | 31·0 |
| ,, | 1909 | ,, | ,, | 5 ,, | 6·480 | 25·5 |
| ,, | ,, | ,, | ,, | 1 ,, | 2·916 | 22·25 |
| ,, | ,, | ,, | ,, | ½ ,, | 1·944 | 20·25 |
| British W. Africa | 1906 | ,, | ,, | 1 penny | 11·340 | 31·0 |
| ,, | ,, | ,, | ,, | ½ ,, | 5·670 | 25·5 |
| ,, | 1907 | ,, | ,, | 1 ,, | 9·450 | 31·0 |
| ,, | ,, | ,, | ,, | 1/10 ,, | 1·944 | 20·25 |
| Egypt | 1885 | ,, | Solid | 1 piastre | 5·50 | 23·0 |
| ,, | ,, | ,, | ,, | 5 ochr | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 2 ,, | 2·50 | 18·0 |
| ,, | ,, | ,, | ,, | 1 ,, | 1·75 | 14·5 |
| ,, | 1916 | ,, | Holed | 10 milliemes | 6·00 | 26·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 5·00 | 23·0 |
| ,, | ,, | ,, | ,, | 2 ,, | 4·00 | 20·0 |
| ,, | ,, | ,, | ,, | 1 ,, | 3·00 | 18·0 |
| German E. Africa | 1908 | ,, | ,, | 10 heller | 6·25 | 26·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 3·00 | 21·0 |
| Morocco (Fr.) | 1921 | Nickel, 90% | Solid | 1 franc | 8·00 | 27·0 |
| ,, | ,, | ,, | ,, | 50 centimes | 5·00 | 23·0 |
| ,, | ,, | Cu.75% Ni.25% | Holed | 25 ,, | 5·00 | 24·0 |
| Tunis | 1918 | ,, | ,, | 25 ,, | 5·00 | 24·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 3·00 | 19·0 |

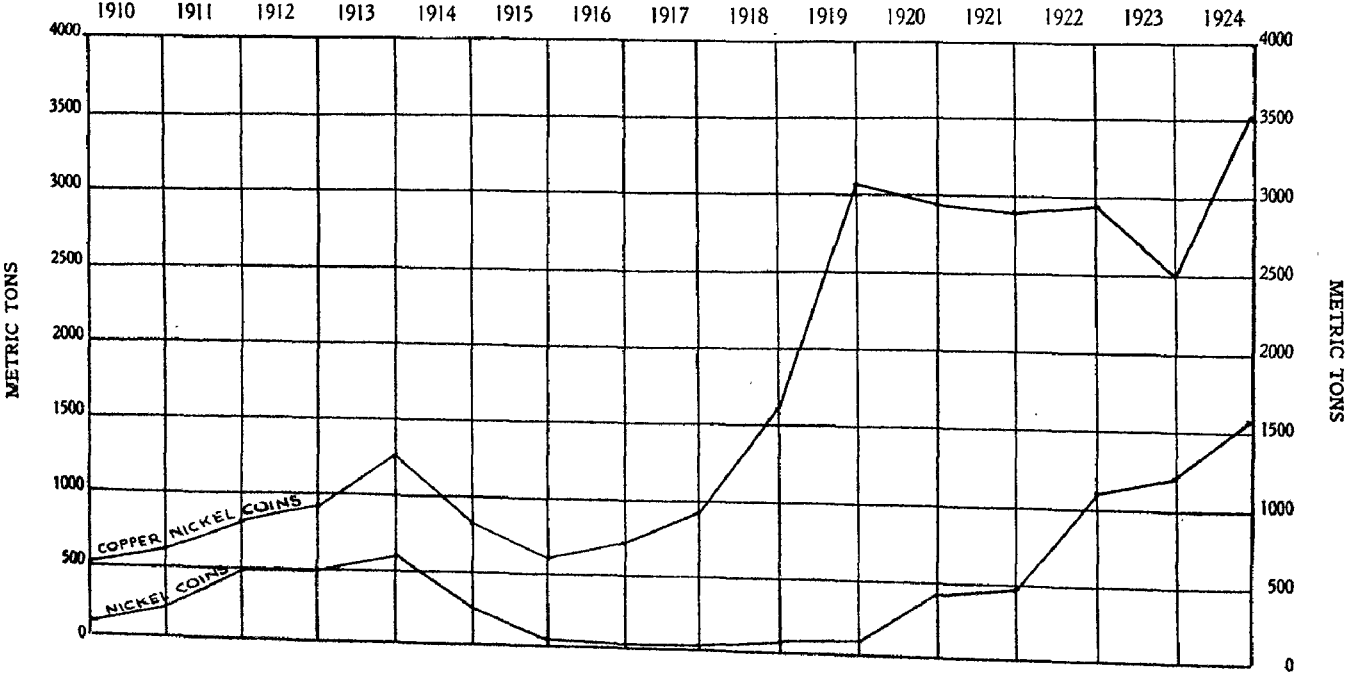
## AMERICA

| | | | | | | |
|---|---|---|---|---|---|---|
| Argentina | 1895 | Cu.75% Ni.25% | Solid | 20 centavos | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 3·00 | 19·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·00 | 17·0 |
| Bolivia | 1908 | ,, | ,, | 10 ,, | 5·00 | 25·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·50 | 20·0 |
| Brazil | 1890 | ,, | ,, | 400 reis | 12·00 | 30·0 |
| ,, | ,, | ,, | ,, | 200 ,, | 8·00 | 25·0 |
| ,, | ,, | ,, | ,, | 100 ,, | 5·00 | 21·0 |
| ,, | ,, | ,, | ,, | 050 ,, | 3·00 | 17·0 |
| ,, | ,, | ,, | ,, | 020 ,, | 2·00 | 15·5 |
| British Honduras | 1907 | ,, | ,, | 5 cents | 3·629 | 20·20 |

| Country. | Date of Introduction. | Composition. | Type. | Denomination. | Weight. Grams. | Diameter. m/m. |
|---|---|---|---|---|---|---|
| Canada | 1921 | Nickel | Solid | 5 cents | 4·536 | 21·08 |
| Chile | 1920 | Cu.75% Ni.25% | ,, | 20 centavos | 4·50 | 22·5 |
| ,, | ,, | ,, | ,, | 10 ,, | 3·00 | 19·5 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·00 | 16·5 |
| Colombia | 1907 | ,, | ,, | 5 pesos | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 2 ,, | 3·00 | 19·0 |
| ,, | ,, | ,, | ,, | 1 ,, | 2·00 | 17·0 |
| Costa Rica | 1904 | ,, | ,, | 2 centess. | 2·00 | 10·0 |
| Cuba | 1914 | ,, | ,, | 5 cents | 5·00 | 21·2 |
| ,, | ,, | ,, | ,, | 3 ,, | 3·50 | 19·0 |
| ,, | ,, | ,, | ,, | 2 ,, | 2·50 | 17·0 |
| Ecuador | 1884 | ,, | ,, | 10 centavos | 16·00 | 25·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 2 ,, | 3·00 | 19·0 |
| ,, | ,, | ,, | ,, | 1 ,, | 2·00 | 17·0 |
| ,, | ,, | ,, | ,, | ½ ,, | 1·50 | 15·0 |
| ,, | 1923 | ,, | ,, | 10 ,, | 3·00 | 19·5 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·00 | 16·5 |
| Guadaloupe | 1903 | ,, | ,, | 1 franc | 5·50 | 25·0 |
| ,, | ,, | ,, | ,, | 50 centimes | 3·50 | 22·0 |
| Guatemala | 1900 | ,, | ,, | 1 real | — | 21·00 |
| ,, | ,, | ,, | ,, | ½ ,, | — | 19·0 |
| ,, | ,, | ,, | ,, | ¼ ,, | — | 13·5 |
| Hayti | 1897 | ,, | ,, | 50 centavos | 10·00 | 29·5 |
| ,, | ,, | ,, | ,, | 20 ,, | 7·50 | 26·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 4·00 | 23·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·75 | 20·0 |
| Jamaica | 1869 | Cu.80% Ni.20% | ,, | 1 penny | 9·450 | 31·0 |
| ,, | ,, | ,, | ,, | ½ ,, | 5·670 | 25·5 |
| ,, | 1880 | Cu.75% Ni.25% | ,, | ¼ ,, | 2·835 | 20·25 |
| ,, | 1906 | ,, | ,, | 1 ,, | 9·450 | 31·0 |
| ,, | ,, | ,, | ,, | ½ ,, | 5·670 | 25·5 |
| Martinique | 1897 | ,, | ,, | 1 franc | 8·00 | 26·0 |
| ,, | ,, | ,, | ,, | 50 centimes | 5·00 | 22·0 |
| Mexico | 1906 | Nickel | ,, | 5 centavos | 5·00 | 20·0 |
| Nicaragua | 1912 | Cu.75% Ni.25% | ,, | 5 ,, | 5·00 | 21·0 |
| Panama | 1907 | ,, | ,, | 2½ centess. | 5·00 | 21·0 |
| ,, | ,, | ,, | ,, | ½ ,, | 2·50 | 16·0 |
| Paraguay | 1903 | ,, | ,, | 20 centavos | 4·00 | 21·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 3·00 | 19·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·00 | 17·0 |

| Country. | Date of Introduction. | Composition. | Type. | Denomination. | Weight. Grams. | Diameter. m/m. |
|---|---|---|---|---|---|---|
| Peru | 1917 | Cu.75% Ni.25% | Solid | 20 centavcs | 7·00 | 24·0 |
| ,, | ,, | ,, | ,, | 10 ,, | 4·00 | 20·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 3·00 | 17·0 |
| San | 1889 | ,, | ,, | 10 ,, | 7·00 | 26·0 |
| Salvador | ,, | ,, | ,, | 5 ,, | 5·00 | 23·0 |
| ,, | ,, | ,, | ,, | 3 ,, | 3·50 | 20·0 |
| ,, | ,, | ,, | ,, | 1 ,, | 2·50 | 16·0 |
| United | 1857 | Cu.88% Ni.12% | ,, | 1 cent | 4·660 | 19·0 |
| States | 1865 | Cu.75% Ni.25% | ,, | 3 ,, | 1·940 | 18·0 |
| ,, | 1866 | ,, | ,, | 5 ,, | 5·000 | 21·25 |
| Uruguay | 1901 | ,, | ,, | 5 centess. | 5·00 | 23·0 |
| ,, | ,, | ,, | ,, | 2 ,, | 3·50 | 20·0 |
| ,, | ,, | ,, | ,, | 1 ,, | 2·00 | 17·0 |
| Venezuela | 1915 | ,, | ,, | 12½ centimos | 5·00 | 23·0 |
| ,, | ,, | ,, | ,, | 5 ,, | 2·50 | 19·0 |

# COMPARATIVE TONNAGES OF PURE NICKEL AND COPPER NICKEL COINAGES STRUCK AND ISSUED THROUGHOUT THE WORLD 1910—1924



# *The ORIGIN and MANUFACTURE of a PURE NICKEL COIN*

## FIRST PHASE

The World's supply of nickel is almost all derived from the Sudbury District, Ontario, Canada; and from the French island of New Caledonia in the Southern Pacific. Of the total quantity mined and refined in present times, more than nine-tenths is furnished by Ontario, and we will assume that the coin which is the subject of the following narrative is derived from nickel mined in that province.

The ore deposits of the Sudbury district are situated at the edge of an elliptical area some forty miles long and fifteen miles wide. They occur in inclined or vertical masses up to several thousand feet in length and of varying width, and extend downwards from the surface of the ground to several thousand feet. To obtain access to the subterranean ore a shaft is sunk with stations at each working level, and from these stations there are driven passages—called drifts and crosscuts—into the orebody. The ore between the working levels, having been blasted by dynamite from the solid mass and broken into pieces, is made to fall or slide down chutes into trucks standing in the drifts and crosscuts, and in these trucks it is conveyed to the shaft to be hoisted to the surface.

The material thus obtained is a mixture of sulphide and rock matter, and the sulphide contains the valuable metals consisting of nickel, copper, a little cobalt, and minute quantities of gold, silver, and metals of the platinum group.

At the head of the shaft there is a crushing, screening, and sorting plant by means of which, as well as by hand-picking, and also by electro-magnetizing machines, a considerable portion of the rock matter is removed. The

ore is then loaded into railway trucks and despatched to the smelter. Here, a part of the low grade ore is dealt with in a concentrating mill to separate the valuable sulphide from the rock substance. The sulphide goes to the sintering plant and thence to the blast furnaces, while the rock is discarded as a tailing.

When received at the smelter the treated ore contains roughly three per cent. of nickel and two per cent. of copper. There it is fed into blast furnaces, with the result that the whole of the remaining rock, and a part of the iron in the sulphide, passes away in the form of molten slag, and by the same operation a considerable portion of the sulphur is burnt off. To get rid as far as possible of the remaining iron, and to reduce still further the sulphur content, the furnace matte is treated in converters. The resulting Bessemer matte contains about fifty per cent. of nickel, thirty per cent. of copper, and whatever precious metals there were in the original ore, the balance being almost entirely made up of sulphur. It is cooled in moulds, broken up, and shipped to the refinery. This completes the first stage of the development of a nickel coin.

## SECOND PHASE

There are four commercial processes for refining nickel : the Orford process, the French and Belgian processes as applied to New Caledonian nickel, the electrolytic process, and the Mond process. The purest nickel is produced by the two latter processes, electrolytic nickel analysing 98·9 to 99·3 per cent. nickel, together with 0·5 to 0·3 per cent. cobalt, a metal which is almost invariably combined with nickel in nature ; while by the Mond process complete separation of these two elements is effected automatically. In continuing this narrative, it is proposed to confine our attention to the latter process of refining.

The Mond or Carbonyl process is the direct outcome of a discovery made in 1889 by the late Dr. Ludwig Mond, F.R.S., and Dr. Langer. They found that finely divided metallic nickel has the property, when brought into

contact with carbon monoxide, of combining with it to form a gaseous compound. They further discovered that this vapour, called Nickel Carbonyl, decomposes on moderate heating into its component parts : nickel and carbon monoxide. The industrial process which was designed on the basis of the natural law thus brought to light is highly complex. The first operation consists in converting the nickel and copper sulphides contained in the converter matte to the corresponding oxides, thus driving off the sulphur. This is effected by calcination in a specially designed furnace. The next step consists in removing the copper, an operation in which about 80 per cent. thereof is separated by means of sulphuric acid. The third step, that of extracting the nickel in a pure metallic state, comprises three more operations. The first converts the oxides of nickel and remaining copper into crude metallic states by reduction ; the second exposes the reduced matte to the action of carbon monoxide ; and the third decomposes the nickel carbonyl. As the outcome of this last step, the well-known Mond nickel pellets are produced, these being formed in the decomposers as the result of the slow deposition of thin layers of nickel, skin by skin, on a central nucleus, in the same way as a pearl is formed in an oyster by seasonal depositions of nacre on an intruded particle of sand. By this interesting chemico-metallurgical process, cobalt-free nickel of a very high degree of purity is obtained.

## THIRD PHASE

We will now suppose that the Government of some country has decided to mint and issue pure nickel money. The manufacture of pure nickel into the sheets or strip out of which the metal coin blanks are punched is a difficult undertaking, and involves the use of high temperature melting furnaces (*e.g.* electric arc or induction furnaces), rolling mills equipped for both hot and cold rolling, and the employment of very heavy machinery. There are few, if any, Government Mints as yet equipped with the plant necessary to effect the purpose.[1] It is

(1) *It is to be observed that these remarks do not apply to copper-nickel, which lends itself to easier and less expensive manipulation. Most mints are equipped with the machinery necessary for rolling copper-nickel coinage sheet.*

the present practice, therefore, when a country authorises the issue of pure nickel money, for the administrative authorities to invite tenders for the supply of so many coin blanks of specified nickel purity, having the exact weights and dimensions authorised by law, to be delivered at their official Mint, where the blanks will then be struck into coins. Let us assume that the Government of some State has placed a contract with an industrial firm for the supply of 50 million pure nickel blanks, of a specified percentage of purity, weighing 6 grams per blank, representing, therefore, a total weight of 300 metric tons of nickel. The contracting firm having purchased in advance the required quantity of nickel, this is melted in an electric furnace in which the temperature is raised to the high point of 1,600° C. (3,392° F.); for pure nickel, like iron, has a very high melting point. The melted metal is then cast into slabs or ingots, which may be square or rectangular, and in practice vary from a thickness of 6 inches to, say, 1½ inches. Following this operation, each ingot in turn is brought to white heat in another type of furnace, from whence it is quickly transferred to the rolls of a powerful rolling mill, between which its thickness is reduced, in successive passes, by about two-thirds. It is then put back into the furnace to be heated again, and is again taken out to be rolled, the rollers being brought closer together between each pinch, until the ingot has been elongated and reduced to a thickness of one-quarter of an inch. The ingot is now sawn through the middle, and the two portions are each reheated and rolled down to about one-eighth of an inch. An original ingot by this time, therefore, has been transformed into two wide sheets of metal, and these sheets are next shorn into strips. To flatten out the strips to the thickness specified for the coin blanks, and to give them polished surfaces, a cold rolling mill is brought into operation. The minutest care is now exercised to obtain the prescribed thickness; for if the nickel strip were as little as 1/1000th of an inch too thick or too thin, the coin blanks cut therefrom would be either too heavy or too light to pass muster. The finished strip of about

1 foot in length by 4 or 5 inches wide is then sent to the blanking machine, which punches out the metal discs or blanks. Here also great care must be exercised to ensure that the prescribed diameter is accurately maintained. The blanks are then individually put through an edging machine whereby the edges are slightly raised and the outside rims made smooth. Being in too hard a state to take the impression of the coin die when struck, it is necessary at this stage to soften them in an annealing furnace, after which they are cleaned and burnished by sawdust in tumbling barrels, and are then ready for delivery to the Mint.

## FOURTH PHASE

During the time that the manufacture of the blanks has been in progress, the Mint's engraving staff has been engaged in preparing the steel dies to be used in striking the coins. The engraving of coining dies was formerly done solely by hand. but nowadays it is performed mechanically by the use of a reducing machine. By means of this ingenious contrivance, the designs for the obverse and reverse of the coins, which have been previously executed in plaster by a medallic artist on a magnified scale, are exactly reproduced in the scale required in the form of steel cameos or punches from which the striking dies are afterwards sunk. The finished dies having been affixed to the coining press the machinery is set in motion, and the blanks drop one by one from a containing receptacle, each blank in turn being automatically pushed into position by a moving metal finger on to a table in which the lower die is embedded, whereupon the upper die comes down upon it with great force. The pressure thus exerted between the two dies causes the metal to " flow," and to prevent the flow from extending laterally, as well as to give the coin a perfectly smooth edge (or a milled edge if required), the blank is surrounded by a steel collar. With modern coinage presses the coins are thus struck at the rate of 50 to 60 a minute. This is the last operation in the manufacture of pure nickel money ; it only remains thereafter for the coins to be put into circulation.

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# INDEX—*continued*